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THE
GEOGRAPHICAL REVIEW

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# AN AMERICAN BOUNDARY DISPUTE

## DECISION OF THE SUPREME COURT OF THE UNITED STATES WITH RESPECT TO THE TEXAS-OKLAHOMA BOUNDARY

By ISAIAH BOWMAN

[With separate maps, Pl. I facing p. 166, and Pl. II, facing p. 168, and Figs. 20 and 21 on Pl. III, facing p. 182]

During the past few years we have seen many thousands of miles of international boundary in Europe confirmed or revised here and there or relocated altogether or left in dispute. Designed to quiet title to land and to create a more stable régime than Europe had enjoyed, the attempted settlement in many cases has given rise to new difficulties. That this was probably inevitable in any program of reconstruction does not alter the fact that in most cases titles to newly acquired land are still insecure. In several instances a plebiscite was held in order that the wishes of the inhabitants might be decisive, but the effect (in Silesia, for example) has been to create fresh issues without altogether allaying the original trouble. The whole of Upper Silesia, the Memel district, the Polish Corridor, and the northern zone in Slesvig are now shown on certain German maps as territory "temporarily" held by bordering powers. For many years the Tacna-Arica district in northern Chile has been represented on Peruvian maps as "occupied by Chile." Unless boundaries become fixed by general consent, or at least confirmed by general acceptance, and their importance minimized in any event by equitable economic agreements, the political map may again be altered with tragic consequences.

To recall these few instances from among the many that lie scattered throughout the world, particularly in Europe, is to gain a fresh idea of the exceptionally fortunate geographical conditions and the wise counsel that led to the union of the thirteen colonies to form one nation, and of the equally fortunate circumstances that led to the extension of one flexible and modern type of government over so large and diversified a part of North America. Our regional problems are often difficult to solve, and it took a four-years' war to settle the worst of them. But boundary questions, as

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distinct from regional disputes, have never had a disrupting effect. Under our constitutional system provision is made for the settlement of boundary difficulties between states by reference to the Supreme Court of the United States as the court of original jurisdiction.

There are many reasons, social, geographical, and political, why it is easy for us to settle boundary disputes between states. It suffices to name one circumstance perhaps more significant than all others combined, namely,

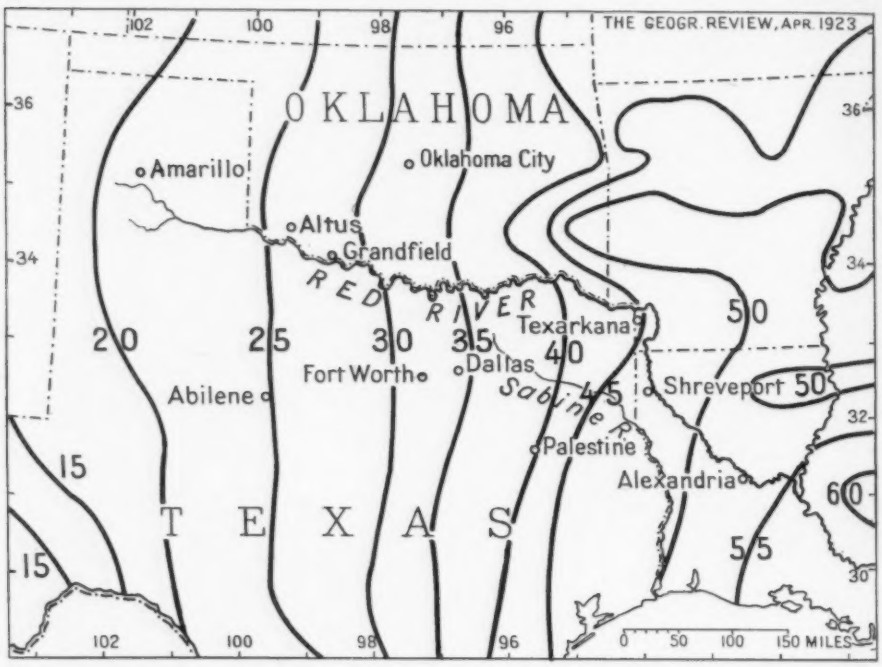



FIG. 1—The Red River is situated in two quite different climatic regions. It rises in the dry region known as the High Plains and flows eastward into the moister prairies. On the above map the mean annual rainfall is shown in inches. The rainfall is more variable and violent in occurrence in the upper Red River than in the lower. This favors the irregular delivery of large quantities of land waste to the main stream but not its ready removal.

that whether a boundary is placed here or there the people concerned live under substantially the same constitutional régime. This means that they enjoy the same liberties of speech and action and suffer no greater or less discriminations based on past wars and persecutions. There are local exceptions to be sure; and we are not guaranteed immunity from regional and racial quarrels. Our watchtowers must always be manned.

## STATE BOUNDARIES OF ECONOMIC INTEREST

Point is given to the disputes that we have, chiefly by reason of the economic (not the political and social) effects of the ultimate decision. Such was the interest in the dispute between Alabama and Georgia in the

famous case of the Chattahoochee, involving the location of an interstate boundary on the western bank of that river. Were a decision to be handed down excluding the inhabitants of one state from access to a navigable river on its border, a hardship would be imposed upon the farming population immediately adjacent and also upon manufacturing and shipping interests that had become accustomed to the use of the river as a highway.

Even if we take such cases into account, the economic interests involved in court decisions affecting streams have not been of the first importance when contrasted with the total economic activity of a given region. Though the use and control of the water of western streams where irrigation is the rule have been fundamental to the life of whole communities, the latter type of decision has not been notably involved in boundary disputes and lies outside the range of our present investigation.

The latest boundary decision of the Supreme Court of the United States relates to the Red River. It disposes of the most complicated boundary dispute on record anywhere; and a settlement of the question involved research in history, physiography, plant ecology, surveying, engineering, and hydrology, as well as the law. From a geographical standpoint the case is undoubtedly unique. It is also one of the tensest cases on record in the United States. Yet by a decision of the Supreme Court a boundary 321 miles long in a straight line, or a distance as great as from Vienna to Berlin or from Berlin to Warsaw or from London or Paris to the Ruhr, was finally settled not by troops, or a plebiscite, or an elaborate treaty, but by a mere pamphlet consisting of fourteen pages of printed text. The only "guards" required about the receivership area, as established by the court, pending a decision, were small white stakes marked "U. S. Supreme Court Temporary Point, No. ——."

## An Unsettled Question for One Hundred Years

The Red River forms the boundary between Texas and Oklahoma for a distance of 539 miles by river, or 321 miles in a direct line. Strange to say, this boundary, although fixed by a treaty with Spain that was signed in 1819 and ratified in 1821, over a hundred years ago, was not settled until January 15, 1923, when the Supreme Court handed down the last of three decisions affecting the question. By the first decision, that of April 11, 1921, the court found "the south bank of Red River" the true boundary between the two states, and not "the medial line of the stream, as claimed by Texas." By the second decision, that of May 1, 1922, the court found that "no part of the [Red] river within Oklahoma is navigable and therefore that the title to the bed did not pass to the state on its admission to the Union." Any claim by Oklahoma to a part of the bed was declared incidental to ownership of riparian lands on the northern bank. The rights of riparian owners on the northern bank to the bed were to extend only to the medial line between the "cut banks" of the river. Finally, by the decree of January 15, 1923, the southerly cut bank was made the

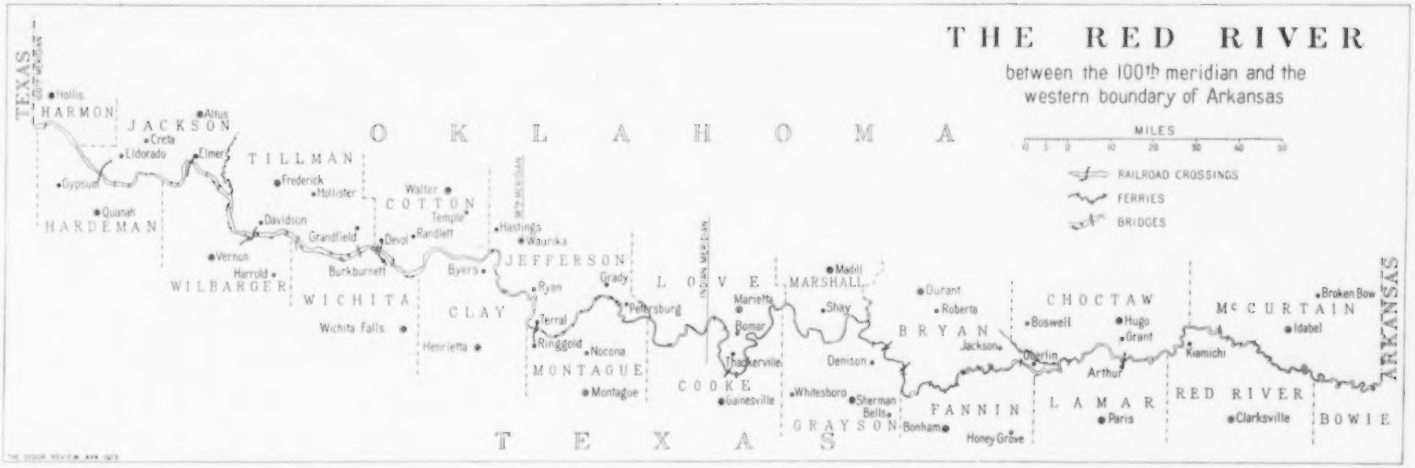



FIG. 2—The Red River here forms part of the boundary between Texas and Oklahoma for a distance of 539 miles following the sinuosities of the stream, or 321 miles in a direct line. The curves and variable widths are shown to scale. Opposite Byers in Clay County the width of the river bed narrows noticeably, and there is progressive and anomalous narrowing *downstream* to the vicinity of Denison in Grayson County. Thence downstream the river widens, though it is nowhere else so wide as in its upper portion from the 100th meridian to Byers. Noticeable also are the large and numerous islands (see Fig. 7) in the upper river and the scarcity of all but small islands in the lower section of the river. The upper river, receiving more waste than it can carry competently, has its course strewn with islands which, with the innumerable sand bars, thrust the river from side to side in the most changeful and pronounced manner. The river in flood flows as a broad waste-laden sheet of water. With rising water there are picked up on the bed of the stream or carried forward from the mouths of tributaries great quantities of material some of which is temporarily deposited again as soon as the supply of water falls off. The moment it is deposited it becomes an obstruction, and the broad sheet of the river is then broken up into a number of separate channels of highly irregular pattern. Farther downstream, where the volume of water is greater at all seasons, the waste is kept under control; the river develops curves of regular pattern; the changes that take place are systematic. The upper river with its island-strewn bed is a braided stream; the lower river is a regularly meandering stream. The "Encyclopedia of Oklahoma," 1912, pp. 11 and 65, defines the Base Line and the Indian Principal Meridian (see center of map) as lines that extend east and west and north and south respectively through a sandstone pillar located one mile south of Fort Arbuckle on the boundary between Murray and Garvin counties. The approximate positions of these two fundamental lines are 34° 31′ N. and 97° 14′ W. From them all land locations in Oklahoma are computed except for that portion of the state west of the 100th meridian. A bridge should have been indicated opposite Byers.

boundary between Texas and Oklahoma so far as surface jurisdiction and use are concerned.

## The United States Owns Half the River Bed

The last decision has one feature of curious interest: *It establishes ownership by the United States of a narrow strip of land on the bed of a stream between the medial line of that bed and the southern cut bank, a strip that shifts its position from flood to flood by two distinct processes (avulsion and erosion) one of which leaves the boundary unchanged while the other alters the boundary.* It excludes not only Oklahoma but also private claimants from ownership of the "soil" in the southern half of the river bed. Private claimants, relying upon placer mining laws, had entered and developed lands in the southern half of the bed. The court held that they had no rights because by the laws and treaties controlling the disposition of lands in Oklahoma the mining laws were excluded. The court recognized the constitutional rule of equality among the states whereby each new state, like the original states, became the owner of the beds of its navigable streams; but by declaring the Red River unnavigable it, in effect, held that the title remained in the United States subject to the Indian rights and then further held that the title to the northern half of the river bed passed from the United States and the Indians to the riparian owners of the north shore, as the lands fronting on the north bank were sold or allotted.

## Geography of the Disputed Zone

With the decisions of the court in mind it will be worth while to examine Figure 1, which shows the general geographical situation and the rainfall; Figure 2, which gives a more detailed view of the boundary zone; and the colored maps, Plates I and II, which give details of the river's course in the most critical part of the disputed zone. It is only after an examination of these four maps that the reader is prepared to follow the next phase of the discussion.

Ten Oklahoman counties and eleven Texan counties border the river along that part of its course which forms a boundary between Texas and Oklahoma. These counties include 11 per cent of the total population of Oklahoma and 9 per cent of the population of Texas. Of the twelve largest towns in Oklahoma but one is within 20 miles of the Red River, and one of the twelve largest in Texas. Nine railway lines cross the river, besides a number of wagon bridges. Within a belt twenty miles wide on either side there are 100 incorporated places; and, of these, 63 are in Oklahoma and 37 in Texas.[1] The valley of the Red is bordered, and its floor throughout the lower or eastern half of the region in dispute is covered, by rich plantations

[1] Of the 63 incorporated places in Oklahoma, according to the 1920 census, one has a population of over 10,000; eight have from 2500 to 10,000; 30 have from 500 to 2500; and 24 have less than 500. Of the 37 incorporated places in Texas, four have a population of over 10,000 (including Wichita Falls, 40,079); ten have from 2500 to 10,000; 15 from 500 to 2500; and eight less than 500.

producing corn and cotton chiefly, and there is a certain amount of stock raising. Added to these interests are those of the oil industry.

In 1918 oil was discovered along the valley; and among the richest oil pools are those that lie under the bed of the river itself and the flood plain and adjacent terraces of the valley floor. The wells are scattered throughout a stretch 43 miles long south of Grandfield, Okla., or south of what was known as the "Big Pasture."[2] Some of the wells are located in the bed of the stream itself (Figs. 20 and 21, Pl. III, facing p. 182). Up to the time that oil was discovered the moderate or normal economic value of the land and of the broad, half-dry bed of the river throughout the upper half of the boundary zone led to the undisputed occupation of the land down to the cut bank of the river on either side; but when oil wells were drilled the question of location became important down to the last foot, not only from the standpoint of the property owner himself but also from the standpoint of the state and its expected increase in taxable wealth.

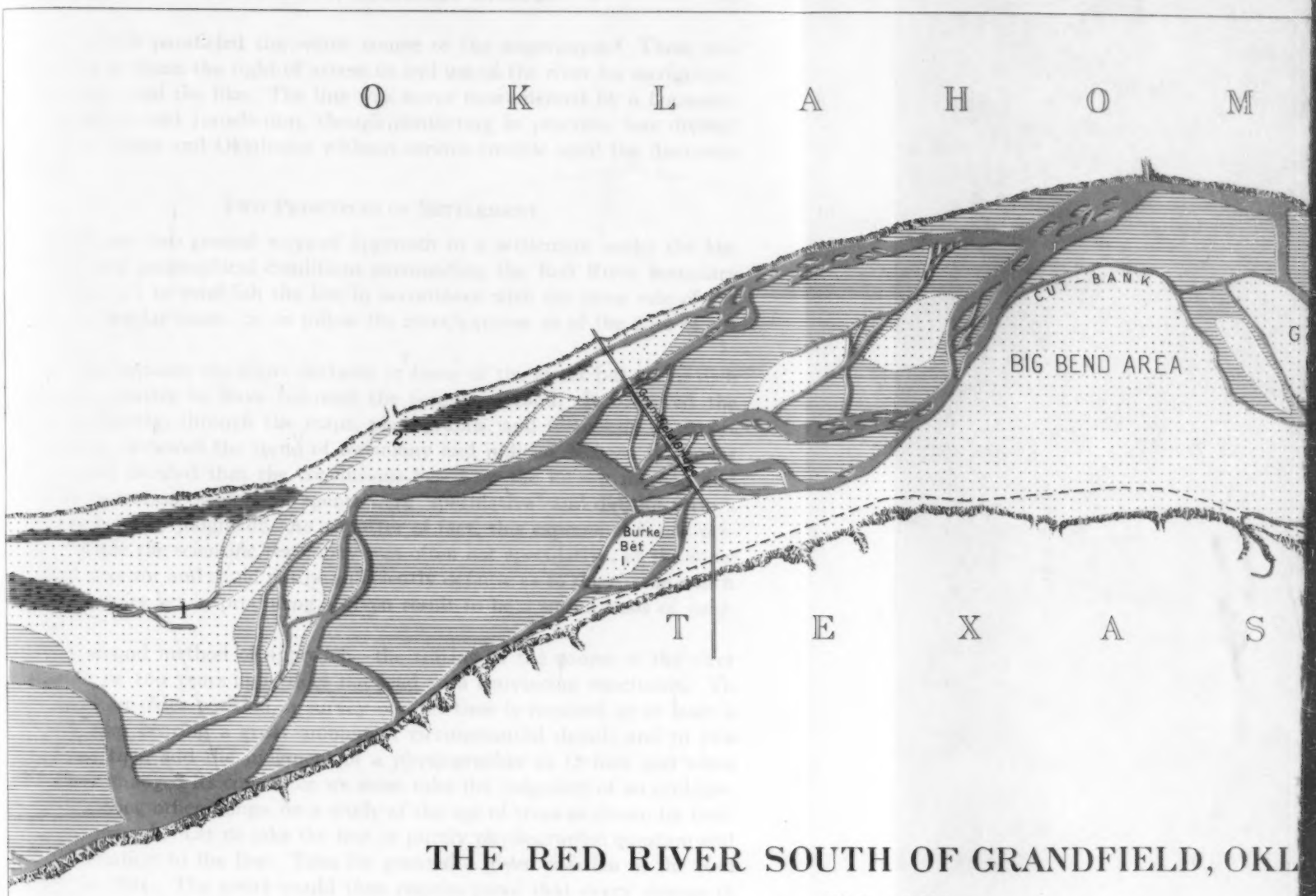
When oil was found at a given point on the floor of the Red River valley four chief questions arose, as follows: Does the land belong to Texas or does it belong to Oklahoma? If it belongs to neither, then it must belong to the north shore riparian owners, including a large number of Indian allottees, or to the United States, or in part to one and in part to the other.

## The Boundary Treaty with Spain

There were added to the whole question certain complicating elements due to the Treaty of 1821 between the United States and Spain, whereby there was established a boundary line between the Spanish possessions and those of the United States along the southern bank of the Red River. The bearing of this episode upon the question in hand is made clear by a brief examination of certain historical facts.

When the United States acquired the Louisiana Purchase in 1803 the limits of that tract were not clearly defined. Various disputes followed as a matter of course; the dispute with Spain was concerned chiefly with the Sabine, Red, and Arkansas Rivers. The course of the Sabine (which now forms part of the boundary between Texas and Louisiana) was agreed to; *the eastern bank and all the islands* going to the United States, the western bank to Spain. The settlement of the boundary on the Red was reached only after protracted and at times delicate negotiations between John Quincy Adams, then Secretary of State, and Sr. Onis, the Spanish Minister. It was agreed in this case that the southern bank was the boundary and that *not only the river but all of the islands* were the property of the United States. The text of the treaty is not altogether clear on the matter of the southern bank; but its meaning is unmistakable upon reference to Adams'

[2] This was one of the grazing reserves created under the Act of Congress of 1900, for the common use of the Indian tribes. The creation of the grazing reserves was part of a plan of terminating the great general Indian reservation established by treaty between the United States and various Indian tribes in 1867. The grazing reserve itself was terminated in 1906.




# THE RED RIVER SOUTH OF GRANDFIELD, OKL

SCALE 1:50,000

1 ¾ ½ ¼ 0 1 Statute miles

1500 1000 500 0 1500 Yards

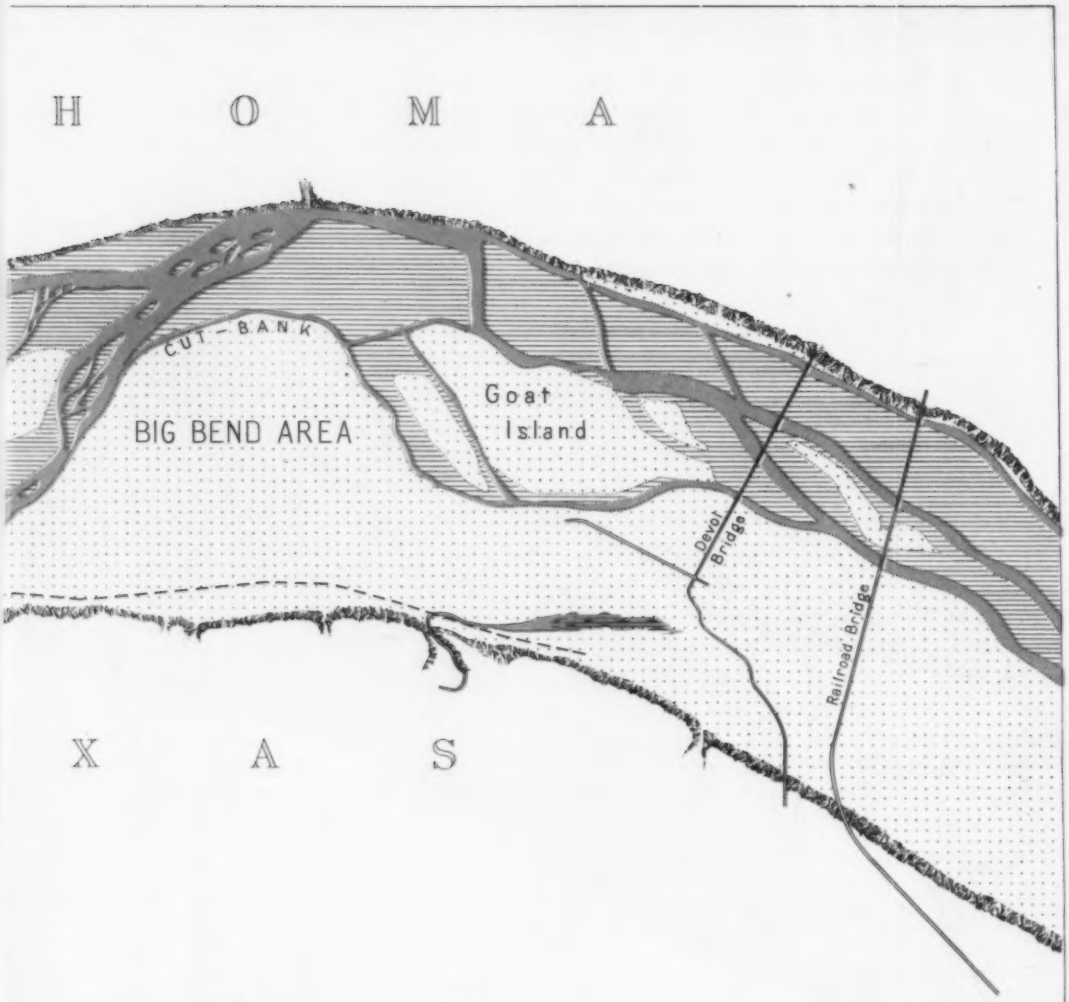
Low-water channels, December, 1919.

Exposed bed of river at low water.

Sand-drifts, flood-plains, islands, and terraces of the valley floor.

--- Southern border of U.S. Supreme Court receivership at the Big Bend

*(After a map by R.W. Livingston of the General Land Office)*




# OF GRANDFIELD, OKLA.

50,000 Statute miles
1500 Yards

cember, 1919.

low water.

nds, and terraces of the valley floor.

upreme Court receivership at the Big Bend

*of the General Land Office)*

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*The Geographical Review, Vol. XIII, No. 2, 1923, Plate I*

diary, which paralleled the whole course of the negotiation.[3] There was reserved to Spain the right of access to and use of the river for navigation, commerce, and the like. The line was never monumented by a boundary commission; and jurisdiction, though conflicting in practice, was divided between Texas and Oklahoma without serious trouble until the discovery of oil.

## Two Principles of Settlement

There are two general ways of approach to a settlement under the historical and geographical conditions surrounding the Red River boundary question: (1) to establish the line in accordance with the prior rule of the court in similar cases, (2) to follow the river's course as of the date of the treaty.

In this instance the court declared in favor of the latter but seems as a practical matter to have followed the former method. It observed the river indirectly, through the maps, photographs, and testimony of expert witnesses; reviewed the trend of testimony and judicial decision in similar cases; and decided that the conclusions based on the known method and rate of operation of physical agents were "speculative" and did not form a reliable basis of judgment. As a matter of fact, this expression is not precise. While the scientific testimony was often not speculative, at the same time it was not and could not be sufficiently definite as to the *time* in which river agencies act in producing a given result to be a sound basis of judgment.

The second method of approach—the tracing of the course of the river in 1821, or 100 years ago—does not lead to a convincing conclusion. To establish an older position, a survey of that time is required or at least a sketch map bearing a great amount of circumstantial detail; and to this we must then add the judgment of a physiographer as to how and when the river changed its course; or we must take the judgment of an ecologist based, among other things, on a study of the age of trees as shown by their rings of growth. Let us take the first or purely physiographic question and see its relation to the law. Take for granted a given position of the Red River in 1821. The court would then require proof that every change in the 500 miles of boundary had been brought about in one of two possible ways: (1) by *erosion and accretion* or (2) by *avulsion*. What do these terms mean and how do they affect boundary location in law?

In a large number of cases it is recognized that a stream, particularly one like the Red River, may shift its bed by erosion of the confining banks upon the one side and (or) by deposition upon the other. The riverward growth of the inner bank of a meander illustrates the process of growth known as *accretion*. When it takes place there is of course a shifting of the river from one side to the other. At a given bend a farm on one side of the river is increasing in acreage by accretion just as a farm on the opposite

[3] American State Papers, Foreign Relations, Vol. 4, pp. 253–256, 530, and 622.

side may be diminishing in acreage as a result of erosion. The law has long recognized that such a change, if on a boundary, *carries the boundary with the river*, whether that boundary is between property owners merely or between states. A moment's reflection on the difficulties of administration and land survey that would follow if an opposite course were taken confirms the wisdom embodied in this rule of law.

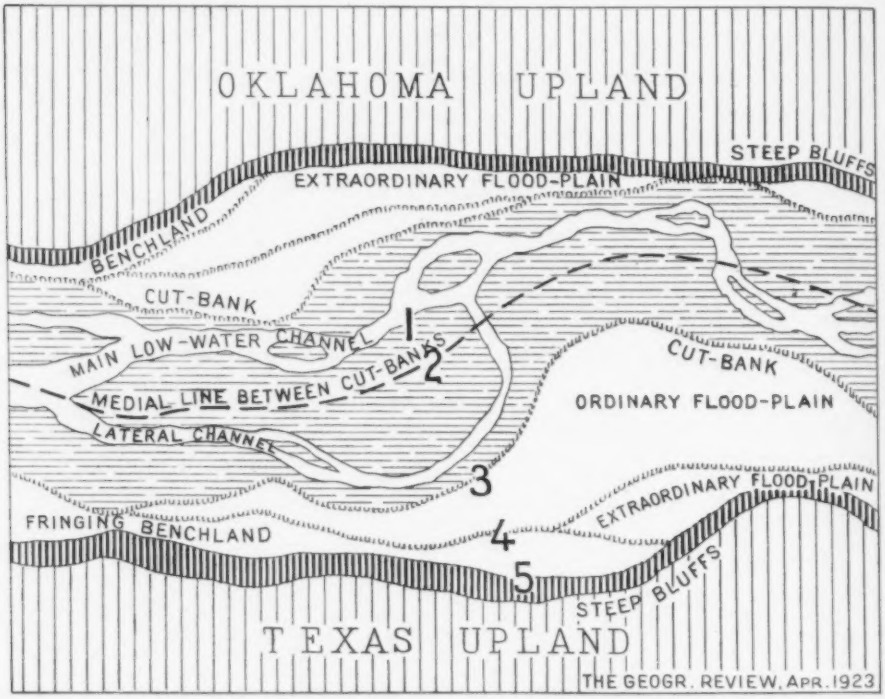
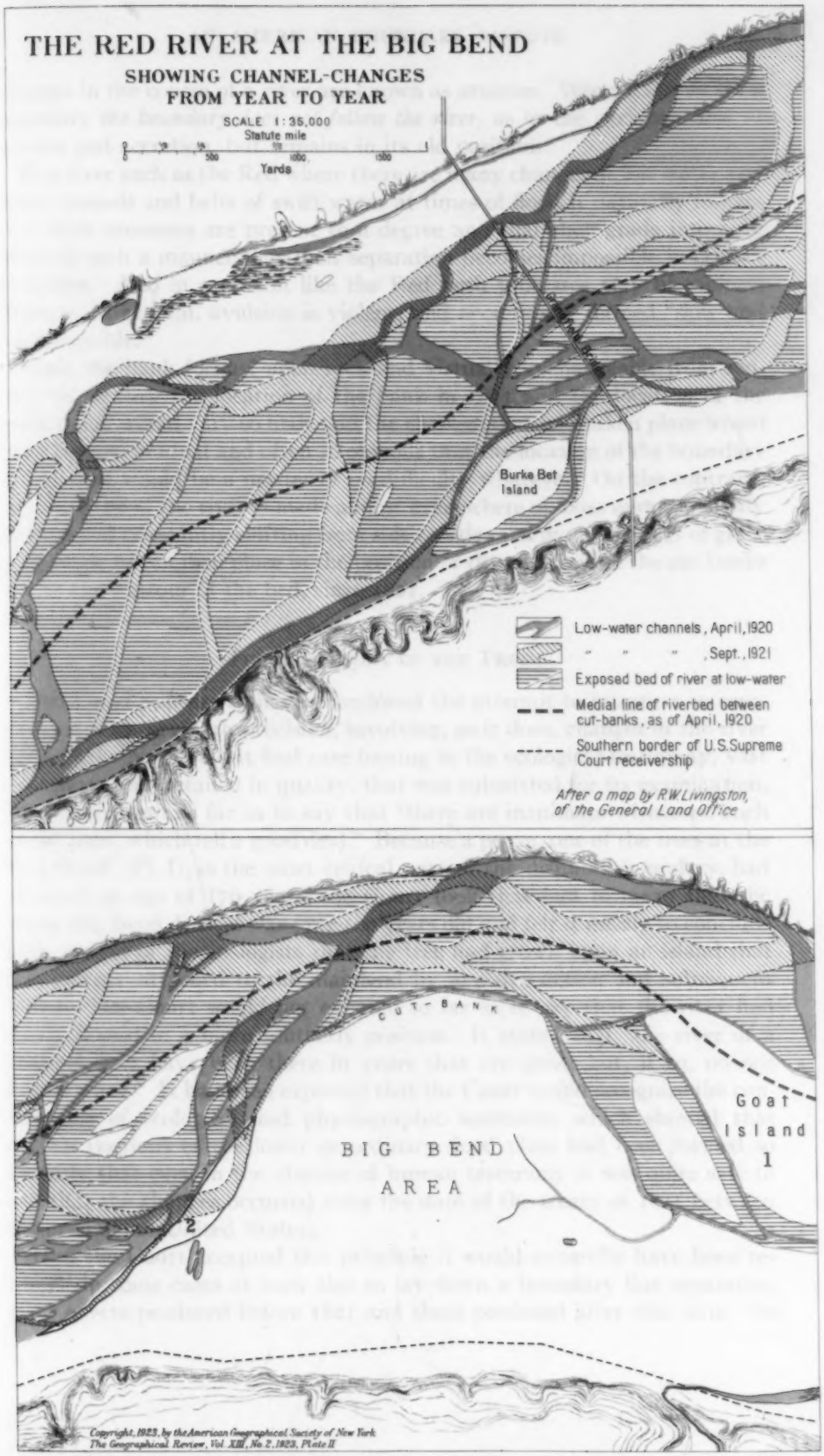



FIG. 3—Composite sketch to show physiographic conditions on the Red River in relation to the Texas-Oklahoma boundary settlement. The Supreme Court has fixed the cut bank (3) as the boundary between the two states. Texas claimed the valley floor northward to the southern edge of the main low-water channel (1). The United States and Oklahoma sought to have the steep bluffs at the southern edge of the valley made the boundary (5). Some of the experts argued for the edge of the benchland or, where present, the extraordinary flood plain (4) on the ground that this would ensure reasonable stability. The ordinary flood plain is channeled, dotted with wind-drifted mounds of sand, and subject to frequent overflow. It is sometimes cut off by avulsion from neighboring fast land and its cut bank is subject to rapid erosion or displacement in every flood. As the cut bank changes so does the medial line (2). The medial line is a property line, not a political boundary. The United States owns the southern half of the bed of this unnavigable stream, and the riparian owners in Oklahoma the northern half. There are two classes of islands: 1, those that lie in the low-water channels as indicated above; 2, those that lie between these channels and the cut banks and are "surrounded by water" during normal and extreme high stages of the river.

On the other hand, it is well known that meandering streams not only enlarge their meanders but that this enlargement in time causes a cut-off across the necks of meander lobes. In such cases the cut-off takes place almost universally at time of flood. When the flood subsides the river is flowing in a new course, and its old course is left in some cases several miles to one side and at a distinct and easily recognized distance. This and similar


THE RED RIVER AT THE BIG BEND
SHOWING CHANNEL-CHANGES
FROM YEAR TO YEAR
SCALE 1:35,000
Statute mile
Yards
Burke Bet
Island
Low-water channels, April, 1920
" " " , Sept., 1921
Exposed bed of river at low-water
Medial line of riverbed between cut-banks, as of April, 1920
Southern border of U.S. Supreme Court receivership
After a map by R.W. Livingston, of the General Land Office
CUT-BANK
BIG BEND
AREA
Goat
Island
1
2
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changes in the course of a river are known as *avulsion*. When it occurs on a boundary *the boundary does not follow the river*, as in the previous case of erosion and accretion, but remains in its old position.

In a river such as the Red where there are many changes at low water and many threads and belts of swift water at times of flood it naturally follows that both processes are present to a degree and that they grade into each other in such a manner that their separation becomes impossible in certain instances. Also in a stream like the Red both processes may be violent; whereas, in general, avulsion is violent, and accretion is termed "slow and imperceptible."

Were the bank formed upon rock and virtually unchangeable from century to century the location of the bank in 1821 and the location of the bank today would vary so little and the changes that had taken place would have been so gradual and often so obvious that the location of the boundary in our time would be a matter of no difficulty whatever. On the contrary, the cut bank of the river is made almost everywhere of loose material, easily eroded, and constantly shifting from side to side; and many changes of great magnitude have taken place in the position of the river and of the cut banks and of the contour of the bed, since 1821.

## The Testimony of the Trees

The Court appears to have abandoned the attempt to interpret so complicated a history with precision, involving, as it does, changes in the river since 1821. Nor could it find sure footing in the ecological testimony, vast in amount and detailed in quality, that was submitted for its examination. The Court went so far as to say that "there are inanimate witnesses, such as old trees, which tell a good deal." Because a pecan, one of the trees at the "Big Bend" (Pl. I), in the most critical part of the disputed boundary, had attained an age of 170 years, the Court took that fact to mean that the whole Big Bend district was over 100 years old and felt it unsafe to conclude with certain of the ecologists that the tree had grown upon an island that had become attached to the mainland by avulsive action and subsequent filling. The Court would not even go so far as to say that the river had surely flowed in a more southerly position. It stated that "the river or a channel may have been there in years that are gone; but, if so, no one knows when." It had been expected that the Court would recognize the convergence of ecological and physiographic testimony which showed that certain portions of the lower or ordinary flood plain had been formed so recently that even in the absence of human testimony it was quite safe to say that the changes occurred since the date of the treaty of 1821 between Spain and the United States.

Had the Court accepted this principle it would naturally have been required in some cases at least also to lay down a boundary line separating river effects produced before 1821 and those produced after that date. So

fine a distinction the experts could not agree upon making, even among themselves; and if they could not agree the Court could not accept the principle upon which they were working as a basis for its own decision, for the judgment of the Court with respect to the evidence of the trees could not be supposed to be sufficiently refined to give it an advantage over one group as opposed to another group. There appeared to the Court to be only one way out of the quandary, and that was to discard the ecological evidence as to the youth of the land and take the age of the oldest tree in a given district, to represent the minimum age of the *whole* district, and not a part of it only.

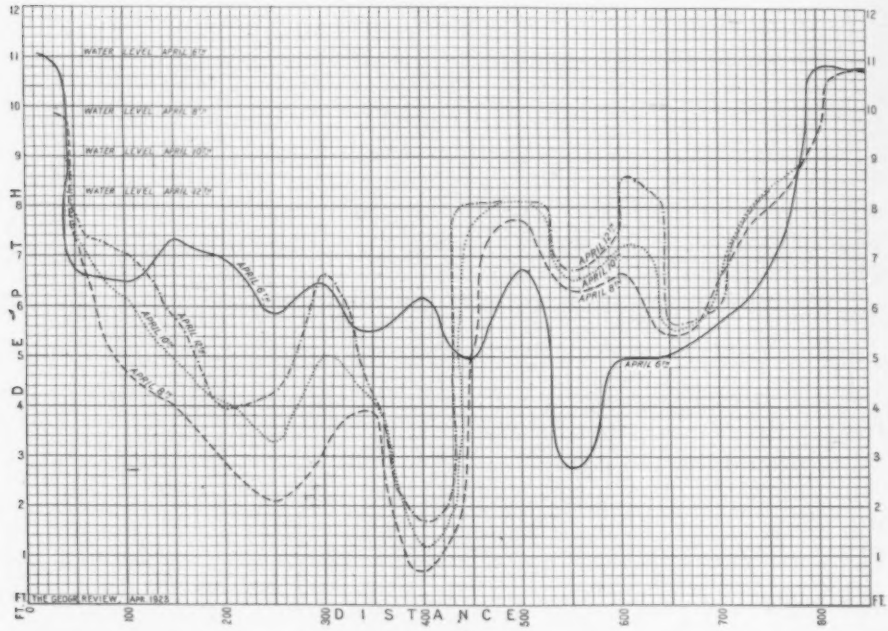


FIG. 4—Changes in the form and depth of the bed of Red River as determined by soundings at the Grandfield Bridge during different stages of a given flood, 1921. The whole mass of sand beneath mean high water is reworked by the river in successive floods and in different stages of the same flood.

## THE TEXAN POINT OF VIEW

We have not exhausted the list of troublesome factors that have made the Red River boundary the most complicated one that has ever confronted the Supreme Court of the United States. There remains the question of the State of Texas itself, how it originated, and its special status in the American Union. It will be recalled that, peopled largely by pioneers from the United States, it became an independent republic after a war with Spain in 1836 and that upon its own appeal it was admitted to the Union and is referred to as the Lone Star State because of the device on its flag when it was a republic (1836–1845). The people of Texas have never forgotten their early history. It was not merely the common problems and dangers of pioneer days that

welded them into a strongly self-conscious community; it was also the struggles and suffering of their own war of independence. The date of the Battle of the Alamo, March 6, 1836, and not the 4th of July, is the celebration that arouses the greater enthusiasm. Local histories abound, and there is a certain sense of detachment from the rest of the United States and of pride in the imperial extent of the state not characteristic of any other American state. Though entitled by Act of Congress to be broken up into not more than four states, the great domain of Texas has been kept a unit.

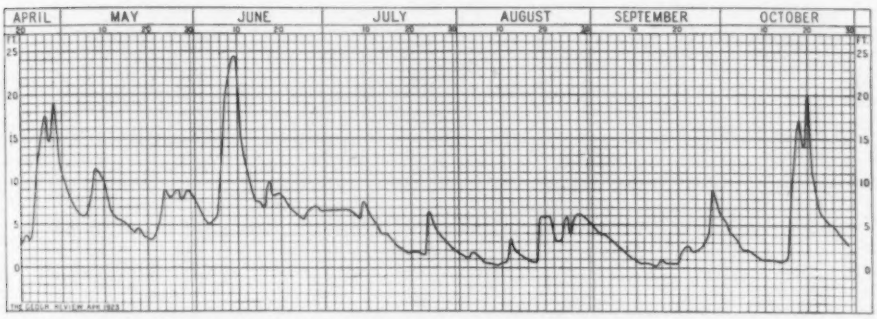


FIG. 5—Gauge readings on the Red River at Denison, Texas, from April 20 to October 30, 1915, after a drawing by the War Department. Included in this period are all the rises in the river for that year except two, the first a rise of 7 feet on March 4, the second a rise of 5½ feet on April 11. By reference to Figure 2 it is seen that Denison is on the lower river. Rises of 10 to 15 feet in twenty-four hours occur several times a year. In the upper river the rises are not so high, but the lateral spread of the stream is proportionately greater. See Plates I and II and Figures 7 and 14.

It is easy to understand, therefore, that the question of the Texan frontier and of the loss or gain of land is a matter of far keener interest to the Texans than similar questions are to the people of other states. It is a matter of economic interest to them as well, for by the terms under which Texas was admitted to the Union her unappropriated public lands were left in her possession, to be disposed of according to her own will, and did not become a part of the public lands of the United States or subject to their administration under the homestead or mineral laws. The state itself has granted patents for the occupation of its empty lands; and it is the state, not the national, treasury that has benefited correspondingly. Though Texas had long administered a great tract between the Red River and the so-called North Fork of the Red, the Supreme Court decided against permanent possession by a decision handed down in 1896. So that the interest of the Texans in the Red River dispute was intensified through the disappointment that followed its earlier loss. In 1920, when the oil dispute was at its height, Texas militia was sent to the Big Bend, land was held in some cases by intimidation and force, and "armed conflicts between rival aspirants for the oil and gas had been but narrowly averted."[4]

[4] U. S. Supreme Court, decision of May 1, 1922, p. 2.

## The Habits of the Red River[5]

The source of the Red River is in the Llano Estacado, or Staked Plains, of the panhandle region of northwestern Texas. These plains lie at an elevation of three to four thousand feet above sea level and are exceedingly flat. Here and there are shallow depressions, and in some of them permanent or semi-permanent waters have gathered. It was long a ranching country, and the land was held in estates of princely extent. In the absence of permanent water over much of the area, wells were drilled to obtain water for the stock. The windmill made an early appearance partly because of the exceptional depth from which the water was drawn and partly because the wind blows unobstructedly over the great expanse of flat land and can readily be harnessed to the task. One of the residents said to me, "Some people complain about the wind, but I think we should be grateful for it. We could not live here without it. It waters our stock."

FIG. 6—The "Breaks," partly cliffed and everywhere prominent eastern margin of the High Plains of northwestern Texas where the Red River takes its rise.

There is a definite eastern margin to the High Plains, a very jagged border known as the "Breaks." The smooth floor of the plain here terminates in a bold scarp which falls several hundred feet to the level of the lower plains to the east. To the people of the region the High Plains are simply "the plains," and the lower country, even where it is locally as smooth as the High Plains, is known as "the prairies." Everywhere the High Plains are covered with grass, except where wheat fields are cultivated. There is no natural

[5] The following description of the Red River is based on a study, by the author, of the region between the High Plains and the western boundary of Arkansas in 1921 as physiographic expert appointed by the United States Department of Justice.

growth of timber. To the rugged aspect of the Breaks there is added the color of patches of woodland and chaparral. Here grow juniper, elm, cottonwood, and mesquite. Eastward from the foot of the Breaks there is also a local timber growth, in the draws, or small tributary ravines, on the walls and floors of box canyons, along the foot of bluffs of any sort where the ground water oozes out to make a belt of better-watered country that sustains, besides trees, a luxuriant growth of grass. All game has vanished from the High Plains. The land is everywhere fenced off for ranches or wheat farms, and the country has an occupied appearance. One is almost never out of sight of a house. The Breaks harbor wild game, and such hunting as is still done in the region is done here. They are many miles in extent from north to south and several miles in width, and the broken character of the narrow belt makes habitation virtually impossible. On the other hand, the prairies are everywhere occupied by farms and only locally by ranches. Such is the scene in passing from the sources of the Red River down to the point where it becomes a boundary between Oklahoma and Texas (100th meridian, Fig. 2).

A multitude of headwater ravines and box canyons in the Breaks at the border of the High Plains are gathered into two main tributaries, Tulia Creek and Prairie Dog Town Creek, which together form the Red River. These headwater tributaries flow over sandstone and, except in wet weather, are clear-water streams until they pass the Breaks and enter the prairies. From this point on, an almost infinite number of ravines are gathered into tributaries which, flowing over soft "Red Beds" detach vast quantities of alluvial material and deliver it to the trough of the Red River. The Red River takes on a very special character from the point near the edge of the Breaks where this alluvial material is dumped into its channel. The alluvium is so soft that the cloud-burst type of rainfall gives the river a very irregular character. It takes from one to seven days for a "rise" to run its course, and the sum total of rises in a given year seldom exceeds forty days in duration. The vast quantities of soil flung into the river at times of rise are in contrast to the absence of waste delivered to the river in the intervening dry season.

Hundreds of tributaries, large and small, may be filled with violent waters in times of heavy rainfall. In a night the river may double or treble its volume as a consequence of far-distant rains or cloud-bursts at the sources of the streams in the Breaks at the edge of the High Plains. When the supply ceases the main stream contracts from a flow in places two miles in breadth filling the whole floor of the valley to a tiny stream that can be forded on foot without the water's rising more than a few inches above the ankles; and in exceptional years the Red River may disappear altogether in the upper parts of its course, enabling one to walk from side to side dryshod.

In times of flood not only does the river carry along the matter left suspended everywhere in the period of drought but also shifts its whole bed for a distance of many feet. The pore spaces in the light sands of the river bed

are filled with water in times of flood, and the whole bed becomes a semifluid mass moving slowly downstream. In years of exceptional rainfall violent changes take place in the course of the river. The current, impinging upon a bank, detaches great quantities of material, to fling it into the stream, whence it is deposited in the form of sand bars farther down. Cut-offs take place not only across the necks of meander lobes but also upon any mass of flood-plain material where the waters may be directed into remnants of older channels or scourways. In the course of a hundred years the river will have changed its position an almost infinite number of times.

As a consequence of the flashy character of the river and the quantities of earth dumped into its bed the volume of water is never long adjusted to the burden of waste. The river has hardly started upon a task when its volume is either increased or diminished. The result is that what the river built an hour ago in the form of sand bar or bottom channel is not adapted to the volume of water that now flows past these features. So from day to day the river finds itself compelled to change the *form and position* of the materials upon which it works or rather with which it struggles. During the long dry spell the currents of the low-water streams show many advances in the process of becoming adapted to the volume of water, the texture of the material, and the gradient of the channel. The next rise sweeps away the results of all these systematic endeavors. The river is almost constantly in a misfit relation to its curves.

If we have in mind this picture of the river's embarrassed flow in the upper part of its course we are able to appreciate the statement that the Red River is here not a single river but a succession of many rivers. Now it is as tiny as a meadow brook flowing lazily through an eastern field, and again its volume is as great as that of the Colorado. Its gradient in places is that of the Colorado, namely, 7 feet per mile (e.g. west of the Big Bend), and its turbulence at times of extreme flood is such that a rowboat could not live in it.

The accompanying sketch (Fig. 7) shows the character of the river when broken up into separate channels. Its appearance is then that of a typically braided stream (Pl. II), much like the Platte in Nebraska, the Majes in Peru, and many others. Figure 14 shows it when it has been reduced to a single thread with a very feeble flow, and Figures 20 and 21, Pl. III, show it at flood stages when it fills the whole valley floor from bluff to bluff and assumes almost incredible proportions.

Complicating the physical geography are the diverting effects of the wind. On days of high wind one may see the whole region enveloped in a cloud of fine dust which penetrates everywhere. The clouds have such blackness and the wind is so violent as to produce a terrifying effect. "Cyclones" (really tornadoes) are not uncommon; and cyclone cellars have been built, partly underground, adjacent to every house. They are used not so much in times of the infrequent tornadoes as in times of the frequent dust storms. Even when winds blow with less violence a vast amount of work is done

upon the valley floor. Thousands of tons of dust are picked up and blown about so that the whole valley to the level of the upland is filled and from above has the appearance of a broad river of dust. At such times also great quantities of the lighter and finer sands are blown along the surface to lodge in the lee of obstructions of every kind whether natural or artificial and to

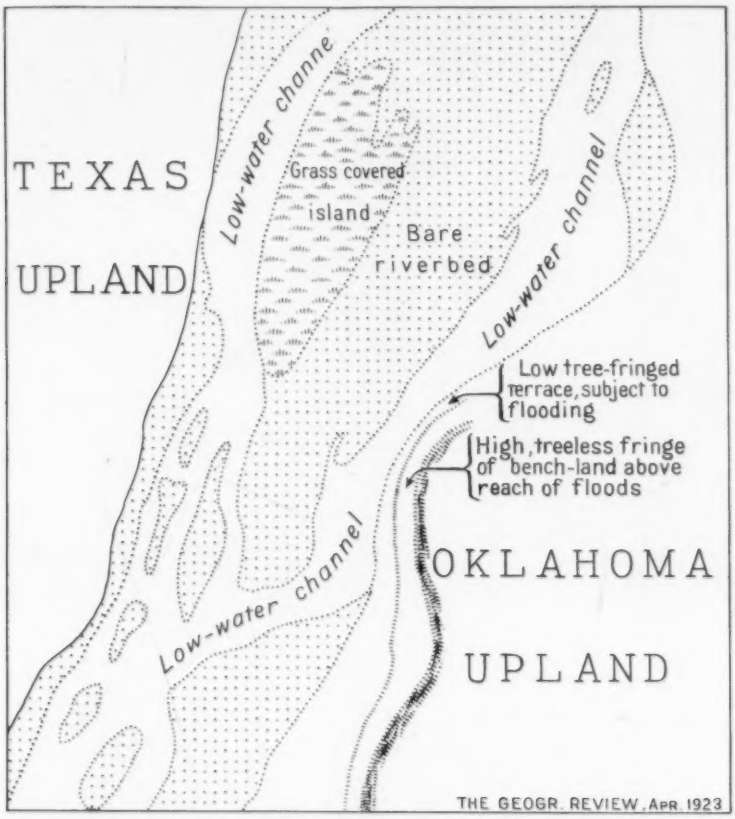


FIG. 7—The Red River in detail northwest of Terral in Jefferson County. The sketch is oriented like a map. It illustrates the braided pattern of the stream in falling stages. During floods or so-called "rises" the river flows bank full, and at extreme stages even the grass-covered island is submerged.

extend and change the shape of sand dunes and irregular ridges of sand gathered by earlier winds.

Naturally these sand accumulations are located in the lee of obstructions. They are scattered everywhere on the dry bed of the river in the upper section and are best developed above and below the 100th meridian. They line the river banks and channels of every sort whether those of low water or of high water. Thus to the changing effect of the river in its flood stages there is added the constant remodeling and building effects of the wind as it shifts the surface material about and clogs channels new and old, turning the waters on their next rise this way and that as they strike the dunes.

FIG. 8

FIG. 9

FIG. 10

FIGS. 8–10—The nature of bed and banks in the upper portion of the Red River. Figure 8 shows the Little Red west of the 100th meridian, one of the main headwater tributaries of the Red River. Its bed and banks repeat the features of the Red, and its heavy load of waste is typical of all the rivers which, like it, flow over the Red Beds and other soft sedimentary layers, detaching vast quantities of waste for delivery to the bed of the Red River. In Figure 9 are shown the low cut banks of the Red just east of the 100th meridian formed on loose sand drifted into place from the exposed bed of the river at low water. The bare and channeled bed is typical. Figure 10 shows the cut bank as it appears looking east from the southern end of Grandfield Bridge; and the heavy sheet of sand left in the river bed as the water subsided after a flood.

FIG. 11

FIG. 12

FIG. 13

FIGS. 11–13—These three figures illustrate wind effects upon the bed and banks of the upper section of the Red River between the Big Bend and the 100th meridian. In Figure 11 light sand is seen blown against the low cut bank. Contrast this bank with that shown in Figure 18. In Figure 12 the wind has raised a high mound which will obstruct or deflect the waters of the next flood and may become a more or less permanent island. In Figure 13 the wind has blown sand into a marshy lateral channel way partly choking it and modifying its contour. Figures 12 and 13 illustrate how islands are sometimes formed and the river deflected into new courses on the low flood plain. The combination of these effects is carried so far in some places as to tie an island to the firmer benchland (Fig. 3).

As we descend the five hundred miles of the river forming the boundary between Texas and Oklahoma the signs multiply that the river gains in its power over the waste on its floor. The river curves become more regular, and halfway down through the disputed zone they take on the pattern of a normally meandering stream, with toe caps, meander cut-offs, flood-plain lobes, steep outer banks, gradually shelving inner banks, and broad flood plains and terraces on either hand. Also as we proceed downstream the number of tributaries entering the river increase, and many of these (e. g. Washita, Kiamichi, Wichita) have their sources not in the dry High Plains with a cloud-burst type of rainfall nor even in the Breaks where springs

FIG. 14—The Upper Red River bed at low water at the Electra Bridge in the northwestern corner of Wichita county looking northward from the Texas bluff toward Oklahoma. For location see Figure 2.

occur but out upon the prairies where the rainfall is more nearly of normal type and where seepage from the ground water is one of the main sources of water supply. It follows that the river is no longer subject to the irregular forces of the headwater region, but has a dependable supply of water and is more regular in its flow. When floods occur there is still a great rise of water. At Denison, for example, the river has been known to rise thirty feet as measured on the bridge pier. When the floods subside the river does not contract to a mere thread but retains the proportions of a true river and, so to speak, resumes the regular work that is only interrupted by the floods.

Where the river is most subject to change, as in its upper course, the locations of its banks also change from flood to flood. The evidences of such change are everywhere, and the local records and traditions are full of instances that have affected the welfare of the communities along the valley. There is no definite break between the upper and lower sections, between a stream subject to the vagaries of wind and flood and a stream in masterful occupation of its valley floor. The change is gradual; and here and there the characteristics of the upper section appear in the lower, but of course to a

more limited degree. For purposes of reference we may take the middle of the disputed zone as the dividing point into upper and lower sections.

## The Red River Is Really Many Rivers in One

Almost all rivers vary in regimen. They have seasons of high water and seasons of low water. They are broad at flood time and relatively narrow at times of low water. What matters to the people of a given valley and what matters in a boundary dispute is the *degree* to which such changes occur. In the more densely inhabited regions of Europe and North America the rainfall is fairly evenly distributed throughout the year, and there is

Fig. 15—Looking west at the tip of the Horseshoe Bend east of Bomar, Love County. On the right is Oklahoma. The river here flows through limestone. Like Figure 17, the photograph shows the definite character of the cut bank in the lower river as contrasted with its indefinite character and changing position in the upper river.

only moderate variation. It results that there has been developed a terminology and even a body of legal decisions which are adapted to rivers of the type we call normal but not to those of an extreme type, such as the Red. In the Southwest generally, as in Mexico, the Spanish language has furnished resources for the detailed description of natural features, and terms thus applied come to have fairly exact meanings. Travelers who return from the deserts of inner Arabia and from the vast desert spaces of the Sahara describe the features of ravine, valley floor, and sand drift, in local rather than our accustomed terms because these are used in more precise and specialized ways.

Since the Red River rises in one climatic region and flows into another, it is one river in its upper course and quite another in its lower course. When the Supreme Court tries to frame a decision that will fit 539 miles of river course in such a case it is precisely as if it tried to frame a decision which should apply equally to a river in western Texas and another river in Ohio. This cannot be done, and to this extent the decision of the Supreme Court

with reference to the boundary between Texas and Oklahoma will be a subject of debate and of litigation for years to come, though it will settle momentarily the immediate question as to who owns the oil and the ranch lands and the plantations along the valley floor.

## A Stable Versus an Unstable Bank

A large volume of testimony had to do with the question of a stable or permanent bank, and this made it possible for both experts and counsel to exhibit *a wide range of opinion concerning stability or relative stability* and the use that the Court would probably make of this principle in locating the boundary. As a matter of fact, the term "stable" does not occur in the final decision. The Court seems to have set entirely aside the principle of stability and the chance it offered to reduce the volume of future litigation. It confined itself to the question of the location of the bank in the ordinary and accepted use of the term.

In order to show the bearing of this decision and its relation to the expert testimony, Figure 3 is introduced. Number 1 in that figure indicates the decision sought by the United States as intervener in the case. Oklahoma asserted ownership of the bed of the river as well as jurisdiction over its surface waters to the south bank, setting up the claim that the river had been navigable at one time and was now navigable in the sense that it *could* be navigated (p. 165); whereas the Court ruled that the river was not now navigable in fact, was not being navigated, and therefore that title to the bed of the stream did not pass to Oklahoma on her admission to the Union.

It is obvious on even a superficial inspection of the region that the cut bank on the border of the river bed is the most natural boundary from the standpoint of the actual residents.[6] Ranches and farms, cemeteries and schoolhouses, churches, fences, cultivated land, roads, cow paths, lanes, and every sign of occupation and civilization extend in many places to the cut bank. When we add to this the fact that Texas exercised jurisdiction and issued patents to lands up to the cut bank, and that without interference from Oklahoma or the United States, the decision of the Court seems to be by far the more natural one to the actual resident if we disregard the future difficulties that river changes will bring. In the light of actual ownership during the past 50 years the decision will commend itself to the inhabitants of the valley and strengthen their sense of confidence in the soundness of our highest tribunal—in itself a highly desirable result.

## Practical Effects of the Decision

The distance from the so-called cut bank to the water is nothing whatever in many places along the lower course in times of normal flow, and there are

[6] Had the Supreme Court decided upon the bluffs along the southern edge of the valley as the permanent bank and boundary it would have involved defining the bed as the whole valley floor.

FIG. 16

FIG. 17

FIG. 18

FIG. 19

FIGS. 16–19—Illustrations of the cut bank of the river. The problem of the boundary commissioners will be to locate their monuments accurately under these dissimilar circumstances. Figure 16—Valley floor and the definite margin in the lower valley in the timbered belt (Red River County) where the river is measurably restricted. Figure 17—A well-defined bank as developed on the outside margin of the meander curves in the lower river (Red River County). Figure 18—Middle portion of the river (Cooke County) where a cut bank is exceptionally well developed. Figure 19—Shallowness of the river and the low and indefinite banks characteristic of many miles of the river border throughout the boundary zone (Montague County).

many other places where no such thing as a true cut bank exists. To this end the Court has wisely stipulated that when the boundary commissioners locate and mark the boundary upon the ground it shall be in accordance with the principles stated in the decision and also that the action of the commissioners is to be subject to the approval of the Court. The spirit of the decision clearly is that there shall not be strips of land lying between the cut bank and the river, situated on the Texan side of the river yet subject to Oklahoma's jurisdiction. On the contrary, the decision is that the territory of Texas shall extend to the edge of the cut bank; and, if a cut bank does not exist, some correlative natural feature, probably a recognizable line of flow at times of normal high water, will be taken to indicate the position of the boundary.

In the upper half of the river at many places the stream at times of low water will be formed of a single thread lying, let us say, upon the Oklahoman side of the bed of the river. The cut bank in the upper part of the river is a far more persistent and easily recognizable feature. Its face is commonly composed of raw earth freshened by the last flood. Its top is crowned with a cover of grass, in places thin, that extends down to the edge of the bluff from the adjacent terraces and uplands. From its foot, out toward the dwindling stream that we have pictured above, there extends a broad waste of bottom sand channeled by the current of the river over most of its extent and bearing a certain amount of wind-drifted and wind-rippled dune material.

Should a farmer who lives upon the southern side of the valley and owns the land adjacent to the cut bank desire to water his stock he would have to drive them in some instances nearly a mile to water over land belonging to the United States (the southern half of the bed) and into land belonging to an Oklahoman riparian owner (the northern half of the bed) in order to reach the stream. Of course he would be wiser to drill a well, and in fact most farmers have wells equipped with windmills; but in the rare case where a ranchman desired to water his stock from a natural flow such would be his procedure.

It was brought out humorously in the testimony that if such a Texas farmer wished to go down to the bank to fish at times of low water he would in certain places have to have a fish pole a mile long in order to fish in the stream to which the Treaty of 1821 solemnly gave him the right of access in specific terms, and his fish pole would have to extend right across a strip of land owned by the United States and project into the farms of riparian owners in Oklahoma.

## The Line of 1821 Is Not Followed

The Court recognized and applied the process of accretion and avulsion in the study of the evidence in the Red River case. It admitted operation of the process but confined itself to a few cases only in spite of the declaration that "The boundary as it was in 1821, when the treaty became effec-

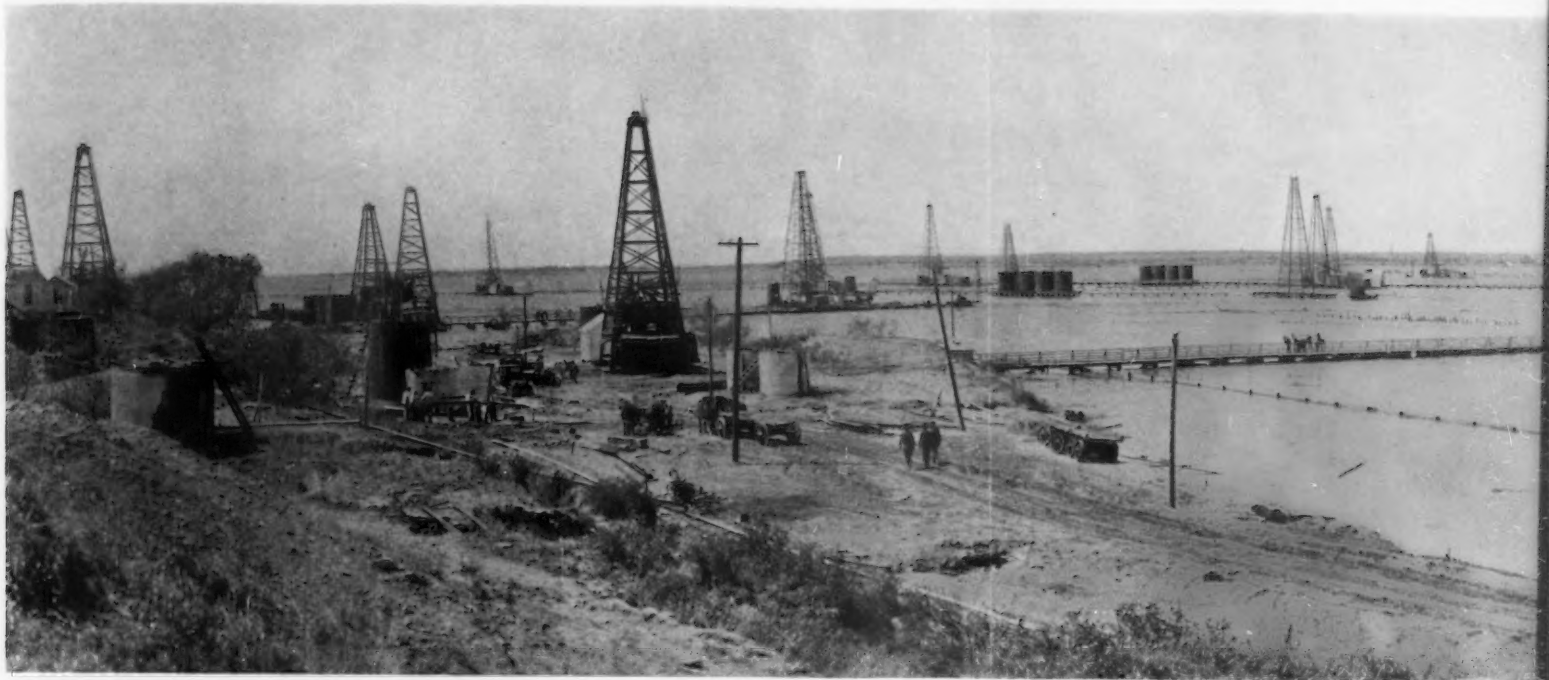

FIG. 20 (above)—The R
graph was taken there ha

FIG. 21 (below)—The
the flood of 1921 this per

FIG. 20 (above)—The Red River in flood from the Texas bluff west of the Grandfield Bridge. (Se
graph was taken there has been an immense amount of filling on the Texas side of the river in the o

FIG. 21 (below)—The Red River in flood from a point west of the position noted in Figure 20, a
the flood of 1921 this peninsula was cut through and the tree-covered point of it then became an isl

e Grandfield Bridge. (See Plate I, opposite p. 166.) The bridge may be identified from three to four inches to the left of the right margin. Other short bridges have been built to
side of the river in the oil territory.

ion noted in Figure 20, and at the western end of the oil territory. The river is in direct contact with the Texas bluff at the extreme left. On the opposite side is a low peninsul
of it then became an island. The new channel now takes the whole flow of the river. The course of the new channel is shown by the figures 1 and 2 on the map, Plate I, opposi

short bridges have been built to the oil wells to avoid flood waters. Since the photo-

ıe opposite side is a low peninsula that extends northward to the Oklahoma bluffs. In
ıd 2 on the map, Plate I, opposite page 166.

tive, is the boundary of today, subject to the right application of the doctrines of erosion and accretion and of avulsion to any intervening changes."[7] An island in the upper part of the river at Mile Post 575, near the line between Hardeman and Wilbarger countries in Texas, was claimed by Texas and given to it by the decree of January 15, 1923, on the ground that it had been a part of the fast land on the south side of the valley up to 1902 "and then severed from it by avulsive action in time of flood;" so that the boundary is made to pass on the north side of the island in recognition of the physiographic processes that operated to make it an island. The amount of land involved is very small, however. It is about a mile in length and a half mile in average width and, so far as I know, has no special economic value. It will be noted that avulsion was established as of a late date and could be confirmed by human witnesses. It did not fall into the class of avulsions which were established by physiographic and ecologic evidence.

The manner in which the Court steered its way between the two processes is best illustrated by its decision in the case of Goat Island and Burke Bet Island. These lie, the one immediately below (east of) the Big Bend, the other west of the Texas end of the Grandfield Bridge (Pl. I). And it is in just this section that the oil interests are concentrated. Texas claimed them on the ground that they were once connected with the southern side of the valley and have since been separated by avulsive action. The Court found that neither island was ever part of the permanent fast land on the south side. By this decision and by further deciding to follow the cut bank around the Big Bend the Court rejected the island-building hypothesis of some of the experts appointed by the United States and Oklahoma. The evidence in support of island building clearly showed, not merely from the physiographic detail of the surface but also from the soil sections made with great care, that the river migrated northward across the valley floor at the Big Bend, partly by the process of accretion but chiefly by the process of avulsion in four main stages. By changes in its channel it left islands behind which, through the deposits of flood water and chiefly through wind action, became connected with the fast land on the south. The proof of this process seems conclusive; and it would appear that in the face of such proof the boundary should lie, not on the cut bank, but farther south.

The trouble with the avulsive principle is that it can only be applied in those cases where the change in the course of the river is a matter of historical record or can be proved by the testimony of living witnesses. If we attempt to fix the date on which the river left a given channel and occupied another by the freshness of the topographic forms, the limits of error are exceedingly wide, so wide in fact that the Court felt in this case it could not accept the judgment of the experts even though their conclusions fell well

[7] The question of sovereignty is rather complicated for the layman in a case of this kind, where the property of the United States lies within the boundary of a state. It appears that the state has police power over the whole of the land within its boundaries. The rights of the United States pertain only to the proper use of the tract it owns, whether in the development of its mineral resources, its forests, or its scenic features. It may sell or lease its rights and the purchasers are subject to the jurisdiction of the state.

within the limit of one hundred years, the time that has elapsed since the treaty of 1821 with Spain.

## Judicial Determination of River Bed

By reference to Plate I and Figure 14 it will be seen that the greater part of the bed of the river is dry at low-water stages. This dry portion of the bed Texas counsel and experts referred to consistently as a "sand plain." It was the Texas contention that the southern bank of the low-water channel should be the boundary because this was the bank to which a Texan would come when seeking the river during most of the year. Had this contention been sustained Texas would have possession in places of all the islands as these exist at high water. This is made clear by a reference to Plate I, opposite page 166, where the main low-water channel is seen, now on the Oklahoman side, now on the Texan side, of the bed of the river. In the former case all of the islands of high water would be included in the so-called sand plain. Realizing this difficulty every effort was made to apply only the elementary definition of islands as "bodies of land surrounded by water." This would have excluded from the application of the treaty of 1821 between Spain and the United States islands surrounded by water only at times of high water. The importance of the definition lies in the treaty stipulation that all the islands were to belong to the United States. The difficulty with this contention depends on the fact that the so-called sand plain is formed by the river, bears every mark of river action throughout the dry period, is moving downstream at times of flood in contrast to the fixed character of terraces and flood plains, and is without vegetation up to the line of the cut bank on either side (see Fig. 9).

Fig. 22—Nature of the cut bank of the Red River north of Ringgold, on the Texas side. Each stage in the fall of the water is marked by a narrow shelf fronted by a tiny bluff. Somewhere between the uppermost and lowermost of the three figures the boundary will now be located; i. e. (according to the text of the decision) at the "mean level of the water when it washes the bank without overflowing it."

If such a view had been supported by the Supreme Court there would have been loosed an incalculable amount of trouble, for all previous cases of

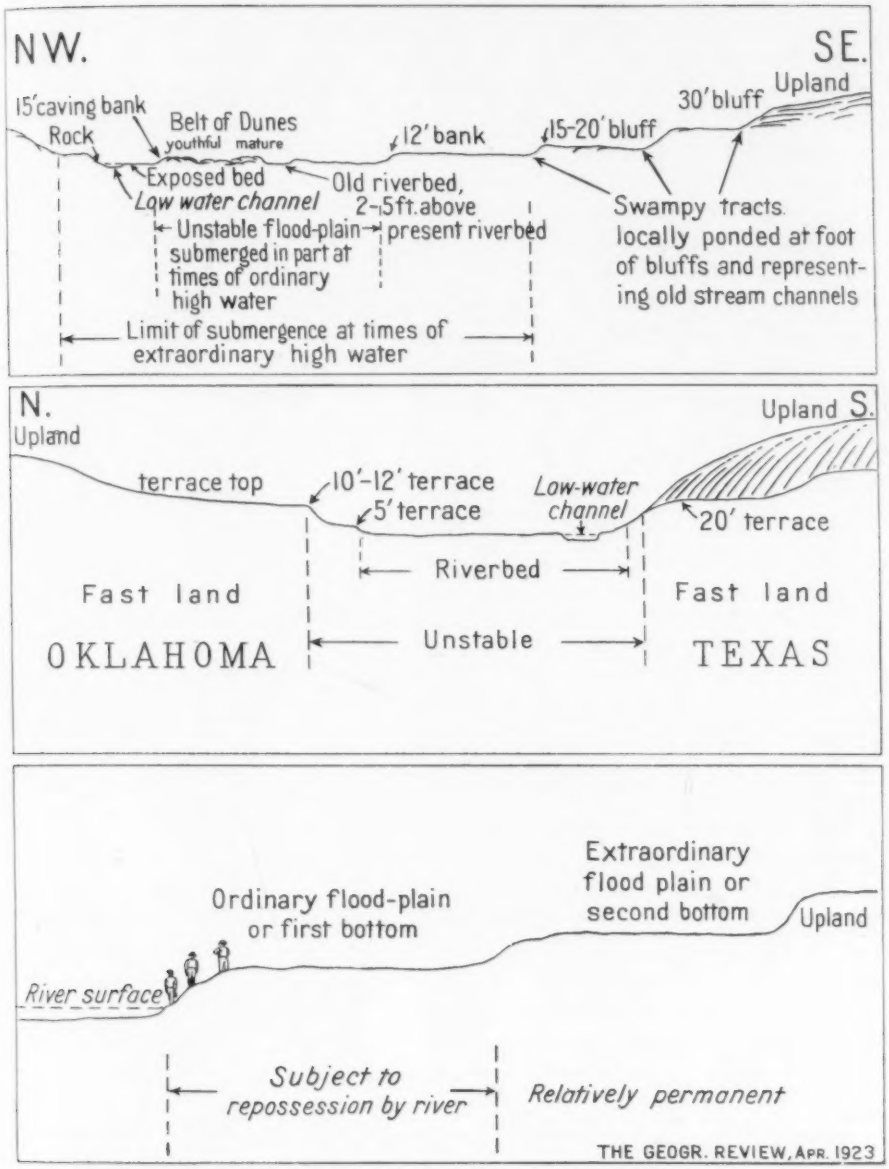


FIG. 23—The form of the floor of the middle and lower portions of the Red River valley is shown by these three typical sketches. In the upper river no such systematic relations are found; on the contrary flood plains of the normal type are often wanting altogether, and the river frequently swings against the margins of benchlands or the foot of the bluffs at the valley margin (see Figs. 9 and 21). The two upper sections are in Grayson County, the lowermost in Montague County.

river boundaries would now be re-examined by interested parties. The reason for this is of special geographical interest. In previous decisions a river has been defined as water flowing in a channel. It has a bed and two banks, so that "water," "bed," and "banks" are three standard features respecting

which a court decision must be specific and conclusive. If we should now place between a main cut bank and the bank of the low-water channel a fourth feature, namely a "sand plain," similar sand plains, however small in extent, would be found on many rivers and inevitably would lead to litigation—inevitably, because there is not elsewhere, as in the case of the Red, the question of ownership merely or chiefly. There are in other rivers questions of navigability and of surface jurisdiction and of the use of the immediate banks in the construction of retaining walls for dams that form parts of irrigation schemes, etc., etc.

This does not prevent us from recognizing the dry river bed as a feature more highly developed in the region of western Texas, and other similar climatic and physiographic regions of the world, than elsewhere. But we should not stop here. The feature is a climatic result chiefly and in the driest deserts of the world it has led to a type of stream still more flashy than the Red and still more abnormal when compared with the streams of the customary type in regions of normal rainfall. Indeed, in the driest deserts, stream channels with bed and cut banks may lie exposed to the air for all but a short season of the year, or, in extreme cases, for years at a time, without a drop of water flowing through them. The return of the water may be so long delayed that sand dunes and irregular drifts may be formed upon the banks and bed. Nevertheless, when the stream comes down again in flood in response to the long-delayed rains these obstructions are modified or cleared away, the bed is remodeled, and the banks are in places scoured afresh.

## Future Litigation Inevitable

It is the purpose of a judicial decision to settle litigation in a broad way and not merely to settle a part of the difficulty and leave the field open for fresh litigation in a new form. In the present case it is certain that a great amount of litigation will ensue, with two property boundaries involved, not merely one. We must recall that the lands of riparian owners in Oklahoma end at the medial line of the river bed and that this boundary may be of equal importance with the cut bank on the south side that forms the common boundary of Texas and Oklahoma. Referring to Plate II, opposite page 168, it will be seen that in a single year the cut bank at the western border of the Big Bend was moved southeastward a distance of 500 feet. Had a well been located upon the cut bank in its earlier position it would then have been in the territory of Texas, but the changes brought about by a single flood would have transferred this well to the territory of the United States; for the river bank gained its new position not by avulsion but by the slow process of erosion recognized in law as a process that carries the boundary into a new position.

## Legally Shifting Boundaries

This is not all. If the cut bank changes at a given point, then the medial line of the bed has also shifted by half this amount provided the opposite

cut bank remains stationary. *The effect of the decision is that both the cut banks and the medial line are constantly on the move legally as well as in fact and hereafter as well as heretofore.* It will result that a well located immediately south of the medial line of the river bed, the property of the United States before a flood, will become the property of a riparian owner in Oklahoma after the flood. This will have its inconveniences, but the Court must have thought it to be the lesser of two evils.[8] In any case, as a practical matter, *it gives to the United States a maximum of the proceeds of the oil actually taken out of the river bed*, on account of the apparent tendency on the part of

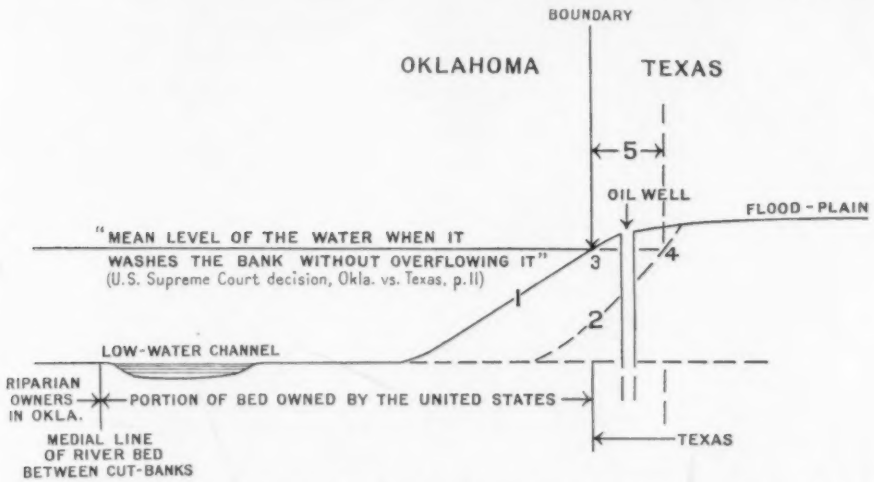


FIG. 24—The figure illustrates one type of difficulty that appears to arise as a result of locating the boundary on the cut bank. If 1 represents the cut bank at noon of a given day when the river is in flood, 2 may represent its position at 4 P.M. In that time the oil well was transferred from Texas to Oklahoma, but, the river being unnavigable, the oil well belongs to the United States though lying in the territory of Oklahoma. If the cut bank shifts to 2, the medial line has shifted to the right also by half the amount of 5, provided the northern or left-hand cut bank has remained stationary. Decrees of the Court or Acts of Congress may affect the oil wells gained by the United States, but those lost by it owing to the shifting of the medial line are permanently lost unless the river should shift at a later time by the same process in the opposite direction.

the river to increase the width of its bed. It seems to be crowding out progressively toward the valley walls on both sides so that the total amount of land eroded on the two sides exceeds the total amount of land elsewhere built up on both sides. The discrepancy is marked, and it may be significant of a continuing process that will greatly advantage the United States in the future extraction of oil from the river bed.

## EXPERT TESTIMONY AND THE COURT

If there is any moral in the experience of the scientists employed in the

[8] It should be understood that these and many similar difficulties that arise in the application of a decision by the Supreme Court may be overcome at least in large part by subsequent decrees of the Court. A *decision* is for the purpose of establishing the principle or principles that are to apply in a given case; a subsequent *decree* is necessary to make the decision effective. The parties in interest confer upon the subject and submit a form of decree for the Court's acceptance or modification; or the Court may frame its own decree. This is to avoid so far as possible the beginning of a new dispute over the meaning of a decision just rendered.

case it is that the present situation whereby experts are employed by the litigants instead of by the Court should be ended at the earliest opportunity. On the face of it it is absurd for a scientific man to be called into a case to give testimony regarding facts under conditions which require him to be intimately associated with counsel and to participate in discussions designed to foil the argument of the opposing side. This is not the spirit of scientific research. Under these circumstances it is only by constant watchfulness that one can avoid importing into the testimony, if not in fact then in spirit, a bias in favor of one side as opposed to the other. This matter has been

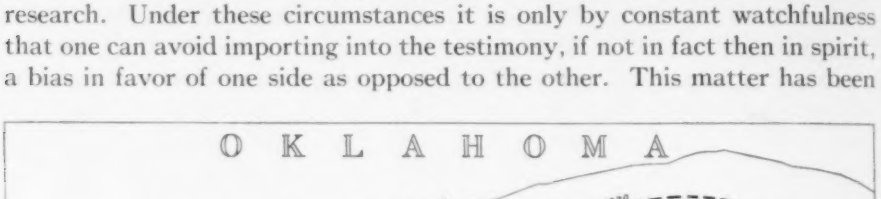


FIG. 25—The position of the producing oil wells in relation to (1) the medial line of the bed of the Red River, (2) the Texas cut bank in the receivership area in the Big Bend district (see Pl. I). This district was the focus of the boundary dispute.

ably argued by Dr. Ransome[9] and cannot be too strongly emphasized when, as in this case, the interests involved are powerful, the State governments determined, and the scientific questions complicated in almost every conceivable way. Then, if ever, it becomes necessary for the expert to take a judicial view, and this he can do to best advantage only if appointed by the Court itself.

To attempt to understand *refinements of scientific testimony as developed by opposing counsel* is to set an impossible task. "The testimony particularly of the experts is conflicting," "We think this testimony is essentially speculative and not a proper basis for judgment." These two sentences from pages 12 and 13, respectively, of the opinion of the Court as handed down by Mr. Justice Van Devanter on January 15, 1923, are suggestive in

[9] F. L. Ransome: Geologists as Expert Witnesses, *Economic Geol.*, Vol. 15, 1920, pp. 339–349.

this connection. On account of the bulk of that testimony (9 volumes of 5513 printed pages, much unprinted testimony introduced by stipulation, two large atlases, in addition to 158 exhibits of photographs, samples of tree rings, soils, etc.) any reader must find his mental apparatus thrown into a state of confusion. Both parties to the controversy were mistaken in their assumption that the subtleties of the testimony would be reflected in the decision, even if the Court could have understood it in all its nuances. Both sides would agree that speculation and theory played a large part in the testimony of the experts, but they would also agree that certain things were definitely established. It would have been interesting, for example, to have had the Court recognize the essential and profound difference between the upper and lower sections of the river and to have adapted its decision to this difference. Instead the Court has treated the river as a unit, and to this extent at least the decision appears to look back to rules of law which hardly seem applicable to so specialized a case rather than forward in the direction of scientific research.

## Detailed Records from Now On

The truth of this last statement is realized if one clearly envisages the future of the river. Upon the ordinary or lower (as distinct from the extraordinary or higher) flood plain, avulsion takes place occasionally in the upper (western) section of the river. One striking case occurred during the progress of the suit, three miles west of the Grandfield Bridge (the change has been from the blue channels of Plate I to the line of depressions marked by 1 and 2). It will be a nice question for a future court to determine the exact character and time of occurrence of stream changes in instances *where avulsion and erosion are inextricably mixed in their action during different stages of the same flood*. The river now needs a diarist to record its capricious behavior in all moods. The airplane camera can secure a part of the record. Trained and continuous observation at critical places seems indispensable. Possibly the oil pools will be exhausted in a few years and before many changes have taken place. When ordinary land values obtain there will be less interest in an exact location of the boundary. The decision says in effect, "We will take the river as it is, and when the inevitable changes come the boundaries will change with them."

# EXPLORATIONS IN EASTERN ECUADOR

By JOSEPH H. SINCLAIR and THERON WASSON

[With separate map, Pl. IV, facing p. 210]

In the latter half of 1921 the writers were engaged in exploring a tract of 9600 square miles in that part of Ecuador lying east of the Andes to determine the possibilities for the eventual production of petroleum. The area was under concession by the Leonard Exploration Company of New York, through whose courtesy the publication of this paper is made possible.

This area is about one-fifth that of the state of Pennsylvania. Nothing was known of its geology, no mapping had ever been done, there were but a few muddy trails, and little knowledge was at hand regarding the climatic conditions. Four months were spent by us in traverses through the jungles on foot and in canoe. Our route, including some back-tracking, amounted to about 625 miles from the point of our departure at the end of the railroad, Pelileo, to our return at Riobamba.

## THE JOURNEY INTO THE ORIENTE

From the Andean highlands the most convenient route into the eastern region of Ecuador, called the Oriente, is to leave the Guayaquil and Quito Railway at Ambato and descend the Rio Pastaza. We first took the railway, known as the Ferrocarril al Curaray, from Ambato to Pelileo. Some 70 miles, of the proposed 180 miles, have been surveyed; but rails have been laid only as far as Pelileo, 21 miles east of Ambato. From this point we set out on horseback on August 11 and proceeded to Baños, situated two miles below the point where the Chambo and Patate Rivers unite to form the Pastaza at the base of the great volcano, Tunguragua. Baños is exactly 30 miles east of Ambato. We found it to be a town of about fifty houses with several hundred inhabitants. It is at an elevation of 6014 feet above sea level and just above the limits of the Amazon jungle. Baños owes its name to hot springs half a mile east of the village. About five miles below here the Pastaza passes over the famous Agoyan Falls, 198 feet high. The snow-capped peaks and glaciers of the watershed above this point furnish a constant supply of water, and it has been estimated[1] that 200,000 horse power could be developed here. Continuing on horseback below the falls, we traveled on a trail notched into cliffs of schist and gneiss 1000 feet above the river, from which height it appears to be a roaring torrent 200 feet wide. Here and there high up the sides of the valley are hanging lateral valleys through which streams enter the Pastaza over falls. Altogether this is one of the wildest valleys imaginable.

[1] C. H. Moore: Railway Construction in Ecuador Just South of the Equator, *Engineering News*, May 14, 1914, New York, pp. 1053–1057.

Several miles below Baños we entered the Amazon jungle. We crossed the Rio Verde by bridge, the Machay by a dangerous ford. At Quebrada San Francisco, 42 miles east of Ambato, we noticed sedimentary rocks for the first time. Similar rocks were seen at the Rio Topo, 50 miles east of Ambato, where a bridge has been built. Shortly beyond the Topo we had to leave our horses, and our journey from there on was on foot. At Mera, 55 miles east of Ambato, at an elevation of 3800 feet, the Pastaza emerges from its great canyon. We found the village to consist of a string of about ten houses. It is in the belt of maximum rainfall.

## Traverse to the Rio Anzu

At Mera our survey started because we could tie our traverse to the survey of the Ferrocarril al Curaray which was run from the Guayaquil and Quito Railway at Ambato. Our method of surveying was as follows. We used a 300-foot length of linen tape treated with paraffin and employed a method used by us on the United States Geological Survey, orienting the traverse board by magnetic needle and then sighting to the voice of whoever was at the head or rear of the tape, taking elevations at each tape length with the aneroid barometer. This traverse was checked at controlling points by latitude observations made on stars with a precise transit. In connection with observations for latitude the true meridian was established at several points by transit observations on circumpolar stars or calculated from solar observations. The compass needle was then read on the established meridian. A Buff precise transit with a five-inch needle was used for this work.

From Mera we followed the Puyo trail across the Rio Pindo Chico and, leaving this near Puyo, turned northeastward through the jungle to the Rio Anzu. At the point where we first reached the Rio Anzu it is about 160 feet wide, flowing in a bed of huge granite boulders. It is very swift and almost waist-deep with the characteristically crystal-clear water of the mountain streams to which Spruce[2] has made reference. We followed the bed for some distance to Embarcadero, 1780 feet in elevation, the head of canoe navigation, having traversed 36 miles through the jungle from Mera without seeing even an Indian hut. We arrived at Embarcadero on August 29 and descended by canoe 12 miles to the village of Napo on the Napo River. On all previous maps the Rio Anzu has been shown as a small tributary of the Napo flowing into it from the west. Our survey showed it to be a much larger and longer river flowing parallel to the Andean chain from the south into the Napo.

The width of the valley of the Rio Napo at Napo nearly coincides with the width of the stream, there being a steep hill on the south bank and only a narrow flood plain on the north bank from which the ascent is rather pronounced to the upland. It is on this narrow flat on the north bank of

[2] Richard Spruce: Notes of a Botanist on the Amazon and Andes, London, 1908; reference in Vol. 2, p. 145.

the river that the settlement of Napo is located at an elevation of 1680 feet above the sea.

## The Settlement of Napo

From the top of the cleared hill on the south bank of the river we looked west over an expanse of forested hills having an average elevation of 2000 feet above the sea. These rise gradually westward to about 4000 feet, where the wall of the Andes cuts them off. On a clear day a fine view is afforded of the snow-capped Andean Range from Antisana on the north to the great volcanic cone of Sangay on the south, a sweep of 120 miles.

The settlement of Napo at the time of our visit was composed of three or four white Spanish-speaking families who have farms of a few acres each on the north bank of the river on which they raise cattle and horses and a few farm products, such as yuca, plaintain, corn, and sugar cane, sufficient only for their own needs. Among these families is that of Sr. Manuel Rivadeneyra, who acted as our guide. Much of the success of the expedition was due to his knowledge of the country and his ability to hire Indian carriers. In Napo, as in the other settlements of eastern Ecuador, no Indians are resident except as servants and laborers for the white families. They are to be found living on small clearings, hidden in the jungles along the streams where they raise yuca and plaintain, fish a little, and also pan gold from the gravels along the bed of the river. Each white family has under its patronage a number of Indians whose gold is taken in exchange for cloth and other commodities obtained from Quito, an eight days' journey northward over a rough trail. We found the families at Napo to be remarkably intelligent, strong and healthy; but, as in the case of all pioneers, forced to depend on themselves in all emergencies. The children are educated at home, and there are no doctors or priests in the region.

The climatic conditions of Napo are very healthful. Temperature readings, taken during our stay from August 29 to September 23, 1921, show an average shade temperature of 77° F. The maximum recorded was 82°, and the minimum in the daytime, 66°. At night, however, especially when it rains, it is much cooler, and covers are always needed in sleeping. We saw no mosquitoes and few other insects. The residents say that there is no malaria at all. Napo is not subjected to excessive rains as are such towns as Mera at the base of the Andes. The residents also informed us that the rains were somewhat greater in the other months of the year, which would indicate a cooler temperature in those months.

We spent twelve days in Napo making preparations for our trip down the river, taking latitude, longitude, and azimuth observations, and collecting fossils.

## Survey of the Rio Napo from Napo to the Rio Coca

On September 5, with two canoes, we started a stadia traverse down the Napo. We used a rod 16 feet long, its feet divisions painted alternately black and white, and a 15-inch Gurley traverse table with a telescopic

alidade, with which we were able to obtain sights 3200 feet long by using one half the stadia interval. The river for 90 miles below Napo is characterized by numerous gravel bars so that we had no difficulty in finding rod and instrument stations.

TABLE I—TEMPERATURE READINGS AT NAPO (1850 FEET), 1921

| | | | |
|---|---|---|---|
| Aug. 29 | 6.00 P. M. | 78.2° F. | showers |
| Aug. 30 | 9.30 A. M. | 77.7 | fair |
| | noon | 78.6 | fair |
| Aug. 31 | 8.00 A. M. | 79.7 | rain |
| | noon | 79.7 | rain |
| | 8.30 P. M. | 79.3 | rain |
| Sept. 1 | 8.00 A. M. | 73.4 | rain |
| | 7.30 P. M. | 66.2 | rain |
| Sept. 2 | 11.00 A. M. | 78.5 | fair |
| | 6.00 P. M. | 77.8 | fair |
| Sept. 3 | 8.00 P. M. | 75.5 | fair |
| Sept. 4 | 6.00 A. M. | 78.0 | fair |
| Sept. 21 | 8.00 P. M. | 78.0 | fair |
| Sept. 22 | 6.30 A. M. | 73.0 | fair |
| Sept. 23 | 9.00 A. M. | 73.9 | fair |
| ? | 7.00 A. M. | 72.0 | cloudy ? |
| | 6.30 A. M. | 68.0 | cloudy |
| | 7.20 A. M. | 72.0 | cloudy |
| | 6.30 P. M. | 77.0 | cloudy |
| | 9.00 A. M. | 75.0 | fair |
| | 11.00 A. M. | 78.0 | fair |
| | 11.30 A. M. | 80.0 | fair |
| | 2.30 P. M. | 82.0 | fair |
| | 3.30 P. M. | 80.0 | fair |
| | 7.30 P. M. | 78.0 | fair |
| | 8.30 P. M. | 76.0 | fair |

The first settlement of white people below Napo is at Remolino de Latas, about five miles down the river, where one or two families live. Shortly below this point the river cuts through the contact of the limestones and shales with the overlying red clays and flows, for the rest of its course to the mouth of the Coca, through red beds and alluvium. The flats along the river here and in many other places consist of gravels 9 to 15 feet thick overlying the clays of the red beds. In places claims have been taken up by an Italian syndicate for gold dredging, but no machinery had arrived at the time of our visit. The next three settlements below Remolino de Latas are: Venecia, 7 miles below Napo on the left bank; a ranch on the left bank of the river 11 miles below Napo; and the cattle ranch of Umberto Garcias 17 miles below Napo. The last-mentioned consists of 290 acres of pasture land on the left bank and 125 acres on the right bank, the large ranch house having a beautiful location on the left bank. We were told the owner had 500 head of cattle, the market for which is far east on the Rio Aguarico, a tributary of the lower Napo.

FIG. 1

FIG. 2

FIG. 1—The Pastaza River at Mera, 3800 feet above sea level where it emerges from its Andean canyon.

FIG. 2—The Napo River 44 miles below Napo. In the background is the Cordillera Galeras with summits about 6000 feet above sea level.

FIG. 3

FIG. 4

FIG. 3—The Napo River 80 miles below Napo.

FIG. 4 —View from the station of the Dominican mission at Canelos across the Bobonaza River to the upland, over 3,000 feet above sea level, between the Bobonaza and Pindo Rivers.

On September 8, from our camp below the mouth of the Rio Arajuno, we observed to the north a prominent mountain range which our guide informed us was the Cordillera Galeras. Thirty-one miles below Napo we passed the next settlement, Santa Rosa. Forty-four miles below Napo we observed a lofty, cone-shaped peak, about 30 miles to the northwest, which we were told was named Sumaco. Vertical angles and intersections to this from several places on our traverse determined the exact location and gave its elevation as 12,700 feet above the sea. Sumaco is beyond all question the most remarkable physiographic feature we saw on the Amazon plain. We believe our expedition is the first accurately to locate it and obtain its elevation. Wolf says of this peak:

> Outside of the Andean region of Ecuador there appears to exist a small volcanic area or perhaps an isolated volcano in the Oriente, in the upper part of the Napo basin; but no geologist has as yet studied it, and I can only describe rumors of its existence. Even the location of this volcano is not very sure.[3]

Humboldt does not show this volcanic peak, for such it probably is, on any of his maps; and Villavicencio, according to Wolf, shows such a mountain at a very great distance to the northeast of the Cordillera Guacamayo. Hamilton Rice,[4] describing his journey down the Napo River, refers to a cone-shaped peak called "Sumaco."

Two more ranches were passed, making seven in all on the banks of the Napo between Napo and the mouth of the Coca. Near the mouth of the Coca there is a settlement called Armenia, consisting of one or two houses. All the settlements along the Napo are occupied by pioneers of a high type. In addition, there are a few Indian families here and there along the river and doubtless others up the tributary streams.

From Napo to the mouth of the Rio Coca is 97 miles by the river traverse. This stadia traverse of the Napo was later increased to a total of 120 miles by the stretch of 23 miles above Napo to the confluence of the Rio Anzu, up this to the Rio Ila, and up the Rio Ila to the base of the Andes. It is the first accurate mapping ever made of the upper portion of the Napo. The nearest to this is a traverse of the lower Napo from Fortaleza, perhaps 60 miles below the mouth of the Coca, to the mouth of the Napo. This was probably a time survey by boat and thus very rough. The map[5] shows no latitudes or longitudes. The stretch of river between Fortaleza and the mouth of the Rio Coca leaves this traverse entirely separated from our work.

The Rio Napo from Napo to the Rio Coca is an excessively braided stream with numerous side channels of shallow depth. Orton[6] in November,

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[3] Teodoro Wolf: Geografía y Geología del Ecuador, Leipzig, 1892, p. 331.

[4] Hamilton Rice: From Quito to the Amazon via the River Napo, *Geogr. Journ.*, Vol. 21, pp. 401–418; Reference on p. 414.

[5] Richard Payer: Der Rio Napo, *Petermanns Mitt.*, Vol. 40, 1894, pp. 169–171, with map "Originalkarte des Rio Napo und Rio Curaray," scale 1:800,000.

[6] James Orton: The Andes and the Amazon, New York, 1870.

1867, found the current of the Napo at Napo to be 6 miles an hour. Measurements by us on September 21, 1921, 60 miles below Napo, gave 5.5 miles an hour. At Napo the river is 300 feet wide and is deep with a swift current. It is subjected to sudden rises from rains in the mountains. At such times boulders can be heard grinding along the bottom. From Napo to Armenia, a distance of 86 miles, the river is characterized by a succession of rapids. The whites and Indians are experts in navigating these in dugout canoes. By poling upstream in the backwash close to the bank and by follow-

FIG. 5—Mt. Sumaco (12,700 feet) seen from Archidona, from which point it lies 28 miles to the north-northeast. The exact position of this isolated peak, probably a volcano, was determined for the first time by the writers' expedition.

ing side channels they are able to travel without difficulty. The river cannot be forded at Napo nor at any point in the hundred miles to the Rio Coca. The bottom is rocky and the water clear to about 11 miles above the mouth of the Coca, where a striking change takes place. Islands disappear, mud banks appear; the river has but one channel one-quarter mile wide with sluggish current, muddy water after rains, and a depth sufficient for small steamers. This change may be considered as marking the "fall line," a characteristic of all rivers of eastern Ecuador. The mouth of the Coca is 850 feet above sea level, and the Napo at this point is 2000 feet across. The Coca is distant 400 miles from the mouth of the Napo, which enters the Amazon below Iquitos, a port for ocean steamers with a draft of 20 feet. The maximum cargo we know to have been poled up as far as Napo was a grand piano, moved by a former governor from Iquitos to Tena, where it is now in use. The return from the mouth of the Rio Coca to Napo took us seven days, an average of 14 miles a day of poling. We had six Indians at work nine hours a day.

### From Napo to Archidona on the Papallacta Trail

The Papallacta Trail is one of the old routes from Quito to the Amazon plain.[7] We mapped 25 miles of it between Napo and the base of the Cordillera Guacamayo.

From Napo to Tena the trail can be negotiated by horses, which by painful experiences have learned to jump across mud holes or plow through them. The trail ascends gradually from Napo, 1680 feet above the sea, to an upland of fairly smooth surface which, between Napo and Tena, is at a maximum of 1950 feet above the sea, 300 feet above the valley bottoms.

Table II—Temperature Readings at Archidona (2000 Feet), 1921

| | | | |
|---|---|---|---|
| Sept. 26 | 3.15 P. M. | 82.0° F. | fair |
| | 4.00 P. M. | 76.8 | showers |
| Sept. 27 | 7.00 A. M. | 72.3 | fair |
| Oct. 1 | 7.00 A. M. | 68.7 | fair |
| Oct. 7 | noon | 78.0 | showers |
| | 7.00 P. M. | 77.0 | fair |
| Oct. 8 | 6.30 A. M. | 67.4 | fair |

This is underlain by nearly horizontal limestones. In places on this upland remnants of the red beds are seen overlying the limestones. Both the limestones and red beds are in places covered by thin deposits of volcanic débris. One white family is found on the trail from Napo to Tena, the house occupying the only clearing in the five miles between these two points. Tena is the capital of the Oriente and the residence of the present governor, whose courtesy toward us helped make our expedition a success. Tena, 1700 feet in elevation, lies on the left bank of the Rio Tena, an easily fordable stream, a mile above its entry into the Rio Misahualli. The settlement is surrounded by clearings where cattle graze and crops are raised, and about half a dozen white families reside here. The Indians live, as usual, scattered in the neighboring jungle along the stream banks. Dr. Jameson, who visited Tena in 1857, described it as having been recently built.[8]

The Rio Misahualli, below the mouth of the Tena and below its tributary, the Rio Hollin, flows in a narrow canyon with precipitous walls. We descended the Rio Misahualli by canoe to a mile below the entry of the Hollin about six miles below Tena. Below this point it has never been descended, as the canyon narrows and the river is full of impassable rapids.

On the Papallacta Trail six and a half miles north of Tena and on the left bank of the Rio Misahualli is Archidona, at an elevation of 2000 feet. This is one of the several "towns" founded in the Ecuadorian montaña in the mid-sixteenth century. For a long time, according to Villavicencio,

[7] For a description of this trail see Manuel Villavicencio: Geografía de la República del Ecuador, New York, 1858, p. 138.

[8] William Jameson: Excursion Made from Quito to the River Napo, January to May, 1857, *Journ. Royal Geogr. Soc.*, Vol. 28, 1858, pp. 337–349; reference on p. 341.

FIG. 6

FIG. 7

FIG. 6—House of one of the settlers at Napo.

FIG. 7—Indians of Canelos in front of the Dominican mission house at Canelos.

it was the key to the Jesuit missions of the Marañon. In 1858 he describes it as having, besides the mission, no white resident but about 300 Indians residing near by in the forest. Today, however, there is no longer a mission station here, nor at Tena, nor at Napo. Archidona consists of four or five white families in as many houses arranged about a public square. Back of the houses and along the Quito trail are cleared pastures which make it a pleasant spot. The summits of the Andean Range dominate the view to the west of Archidona, and to the north rises the Cordillera Guacamayo. But the most striking mountain feature to be seen from Archidona is the great isolated cone of Sumaco, 28 miles to the north-northeast.

On October 1 we left Archidona on horseback by the Papallacta Trail and turned aside four miles north to follow on foot a newly cut trail eastward to the Rio Jandachi. The Jandachi we found to be a roaring torrent, 50 feet wide, occupying a narrow canyon, sunk to a depth of about 735 feet below the upland surface. We saw this stream again some miles farther north at the base of the Cordillera Guacamayo. The surface between Napo and the Cordillera Guacamayo is in general a dissected plateau rising in elevation from 2000 to 4000 feet at its contact with the wall of the Cordillera Guacamayo. A striking feature of the plateau surface is the presence of huge granite blocks, often as large as a house, lying on perfectly undisturbed sedimentary rocks. These may be erratics of glacial origin. The rocks of the plateau on the south side of the Jandachi valley terminate abruptly and without disturbance against the old granitic core of the Cordillera Guacamayo which rises to about 8000 feet above the sea. Further study will be necessary to work out the relations of the Cordillera Guacamayo, the Cordillera Galeras, and Mt. Sumaco to the surrounding sedimentary rocks. It is probable that the Cordillera Guacamayo is composed of granite and schist and is an offshoot of the Eastern Cordillera, the fault line of the Andes here making a salient to the east.

We did not ascend the Cordillera Guacamayo but returned the 26 miles to Napo and on October 17 started poling up the Napo and Anzu Rivers to Embarcadero, the terminus of our trail from Mera, and head of canoe navigation. From Embarcadero we traversed a short distance up the Rio Ila to a point where the red beds disappear beneath a basaltic lava flow near the base of the Eastern Cordillera of the Andes. This is a very interesting locality on account of the absence of disturbance or metamorphism in the red beds right up to the contact. This, together with the horizontal position of the limestones at the base of the Cordillera Guacamayo, is very striking and in sharp contrast to the contact on the western side of the Andes.

### Survey from Napo to Canelos

The usual route from Napo to Canelos is by an old Indian trail to Puyo and thence via Indelyama to Canelos. We felt it necessary, however, to study the geological structure east of this route and decided to attempt a

traverse through the jungle, although warned of dangerous Indians and the lack of a trail. On October 27 we left Napo, striking southeast. The surface is more dissected into sharp hills and ridges and has more streams than north of Napo. The first large stream encountered was the Puni-yacu which, although 150 feet wide, was shallow enough for us to ford. We reached the Rio Arajuno at a point where it is 200 feet wide. This, like the Napo, is divided into many branches and has a swift current of very clear water. We continued the traverse by stadia for some distance up the river bed, camping on October 29 at an Indian's hut. On November 1 we reached the Rio Curaray. The upland surface between the two rivers attains

TABLE III—TEMPERATURE READINGS AT CANELOS (1690 FEET), 1921

| | | | |
|---|---|---|---|
| Nov. 9 | 3.00 P. M. | 76.1° F. | fair |
| Nov. 10 | 7.15 A. M. | 68.0 | cloudy |
| | 8.15 A. M. | 70.0 | cloudy |
| | 10.15 A. M. | 72.0 | cloudy |
| | noon | 77.0 | cloudy |
| | 1.00 P. M. | 78.0 | cloudy |
| | 2.15 P. M. | 81.0 | cloudy |
| | 3.30 P. M. | 81.0 | cloudy |
| | 6.00 P. M. | 80.0 | cloudy |
| | 7.30 P. M. | 76.0 | cloudy |
| | 8.30 P. M. | 75.0 | cloudy |
| Nov. 11 | 8.30 A. M. | 72.0 | fair |
| | 10.00 A. M. | 76.0 | fair |
| | 11.00 A. M. | 80.0 | fair |
| | 1.00 P. M. | 82.0 | fair |
| | 4.00 P. M. | 80.0 | fair |
| | 6.30 P. M. | 78.0 | fair |
| | 10.30 P. M. | 70.0 | fair |
| Nov. 12 | 6.30 A. M. | 76.0 | fair |
| | 8.30 A. M. | 68.0 | cloudy, rain |
| | 9.30 A. M. | 67.0 | cloudy, rain |
| | 1.00 P. M. | 72.0 | cloudy, rain |
| | 3.00 P. M. | 73.0 | fair |

a maximum of 2040 feet above the sea and is well forested. The Curaray River is a winding, shallow creek about 30 feet wide and, where we left it, is 1815 feet above the sea. At one place on the river we found the ruins of an old Jesuit mission, only another indication that the upper Curaray, like much of the Oriente, at one time supported a larger population than at present. The interstream area between the Curaray and the next river south, the Rio Villano, is six miles wide, and the divide attains summits 2820 feet above the sea. We crossed the divide on November 5 and camped on the Rio Villano at an Indian hut 1740 feet above the sea. On November 6, crossing another upland of 2390 feet maximum elevation, we proceeded 12 miles to Canelos along the Rio Bobonaza. The 50 miles through the forest was without trail, and a large part of the journey consisted of wading in streams. Only three Indian huts were seen in all this distance.

We found Canelos to consist of the residence and church of the Dominican Mission; a house used by a government official, vacant at the time of our visit; and the house of a white settler who has lived here with his family for many years. There were three priests at the mission, and while we were at Canelos a fourth arrived from Puyo. The mission, which has been maintained with periods of abandonment for at least 200 years, consists of two large, substantial buildings having red tile roofs—the finest buildings we saw in the Oriente. Father Leon, the present head of the mission, has been there 30 years. Canelos is situated on a beautiful plain overlooking

TABLE IV—TEMPERATURE READINGS AT ALAPICOS (3080 FEET), 1921

| | | | |
|---|---|---|---|
| Nov. 20 | 3.15 P. M. | 65.0° F. | rain |
| | 4.00 P. M. | 65.0 | rain |
| | 5.10 P. M. | 64.0 | rain |
| Nov. 21 | 6.00 A. M. | 62.6 | clear |
| | 7.00 A. M. | 63.5 | clear |
| | noon | 80.0 | clear |
| Nov. 22 | 6.30 A. M. | 68.0 | fair |
| | 1.15 P. M. | 76.1 | fair |

the Rio Bobonaza at an elevation of 1690 feet above sea l vel. The settlement is surrounded by pastures and farms where one of the priests who is a farmer has fine cattle and raises excellent vegetables with which we were generously supplied. There are few mosquitoes and no malaria. During our stay the average daytime temperature was 75° F. with a maximum of 81° and a minimum of 68°. The small range of temperature is a striking characteristic of this entire country. Canelos is important as the terminus of one of the important land routes from Ambato via Baños, Mera, and Puyo to the Oriente; for here the Bobonaza becomes navigable, and canoes in ten days can reach the Pastaza at Andoas, head of navigation on that stream. The reason for crossing from Puyo on the Pastaza River to the Bobonaza is that the Rio Pastaza is not navigable for canoes for many miles below Puyo.

## SURVEY FROM CANELOS TO ALAPICOS

Thanks to the assistance of the Dominican Fathers we secured Indians to carry our packs and left Canelos on November 13 to survey the trail to Alapicos on the Rio Palora, a tributary of the Pastaza. We followed the Puyo trail for 12 miles to Indelyama, which consists of one or two Indian huts on the left bank of the Rio Pindo. At Indelyama the Pindo is 50 feet wide, about two feet deep, and very swift. Here we obtained two canoes and made a stadia traverse of the Rio Pindo to its confluence with the Rio Pastaza, a distance of about five miles. It proved to be a dangerous stream for canoeing on account of the bad rapids. The recently opened trail which follows the left bank should be used by all means.

The Pastaza at the mouth of the Pindo is divided into two channels, each 300 feet wide, separated by an island 1900 feet wide at low water.

The river is not navigable for many miles below this point; certainly the point of navigation would be well below the mouth of the Palora. The grade of the Pastaza between Ambato (8100 feet) and the mouth of the Alpa-yacu just below Mera (3800 feet), where the Pastaza comes out on to the Amazon plain, is one per cent, or 52.8 feet in the mile; between Mera and the mouth of the Pindo the grade is about 40 feet in the mile.

From the Pastaza to Alapicos the distance is 13 miles by trail, a large part of which is through water on account of the extraordinary number of small streams, the smallest of which is knee deep and 10 feet wide.

FIG. 8—The volcano Sangay (17,459 feet) seen from Macas at a distance of 26 miles. Wolf described Sanguay as one of the most active of the world's volcanoes.

Alapicos is on the left bank of the Rio Palora at an elevation of 3080 feet and consists of one white Spanish-speaking family and a mission residence and church. There were no priests there at the time of our visit. The Indians in the vicinity are Jíbaros,[9] the Pastaza River being the boundary between these tribes and those speaking the Quechua language.

The dominating feature of the landscape at Alapicos is the great volcanic cone Sangay, 28 miles west, rising to an elevation of nearly 17,500 feet, with 2000 feet of its cone covered with perpetual snow. Of all the volcanic cones of the Andes seen by us Sangay stood first for perfection of form.

On November 23 we obtained canoes and crossed the Rio Palora, which is 300 feet wide and has a terrific current even at low water. Thence a traverse of 35 miles brought us to Macas. Our route lay across a jungle-covered, smooth-surfaced plateau of volcanic agglomerate. We passed three Jíbaro settlements, one of which consisted of four huts. In one of

[9] On the Jíbaros see J. L. Hermessen: A Journey on the Rio Zamora, Ecuador, *Geogr. Rev.*, Vol. 4, 1917, pp. 434–449.

these the head of a woman was being reduced in accordance with the terrible practice engaged in by the people.

## Macas, Chief Town of the Oriente

Macas is a town of about 500 white people, the largest of the Oriente. It is situated on the south bank of the Upano River on a volcanic plain some 150 feet above the river bed, at an elevation of 3580 feet. It is several miles east of the base of the Cordillera Oriental, out of which the Upano emerges through a great canyon. Each house is in the center of a little

Fig. 9—A fine example of a braided stream. Looking up the Upano River from Macas (3580 feet). The stream bed is cut in a volcanic plain.

farm. Owing to the fertility of the volcanic soil a large variety of foodstuffs is grown, and the region is famed for its magnificent cattle for which, however, there is no market. Macas, like the other towns, is exceptionally healthful; for there are no mosquitoes, the water supply is pure, and it is probable that the mean yearly temperature does not exceed 72° F. We were favored by a visit from the school children of Macas on the day after our arrival and were impressed by their intelligent faces, cleanliness, and healthiness. The Comandante, Sr. Manuel J. Bejarano, and his secretary made us welcome and gave us rooms in the house formerly occupied by Dominican priests. They assisted us in getting cargo carriers for the trip to Riobamba.

Across the river from Macas is the probable site of Sevilla de Oro, one of the famous montaña towns of the sixteenth century, of which today nothing remains except the mythical tales of its greatness. It is said that in the early days the Spaniards had a horseback trail all the way to Macas

FIG. 10

FIG. 11

FIG. 10—Andean lakes 12,000 feet above sea level: that in the background is the source of the Chambo River, affluent of the Pastaza, that in the foreground of the Upano River.

FIG. 11—Meanders in the Chambo valley. Typical *páramo* country, elevation over 11,000 feet.

from Riobamba on the Andean plateau, but today horses can be ridden from Riobamba only as far as Chanala, just east of the summit of the Andes, and should be taken only as far as the lakes at the head of the Upano River. The rest of the journey demands several days of wallowing in mud and of ascending and descending high ridges.

On December 2 we left Macas by the Upano Trail which, after following a swamp for a few miles, climbs up and down a succession of steep ridges. At times the trail narrows to a trench hardly wide enough for a man to pass through and is knee-deep in mud, with vertical walls 15 feet high, the result of many years of use and no repairs. On the fourth day of walking we reached the village of Chanala (8298 feet), the first settlement west of Macas, where about 20 whites and Indians live. Thence crossing over a pass 10,000 feet above the sea we reached the village of Zunac (9052 feet), occupied part of the year by the inhabitants of Chanala but deserted at the time of our arrival. Shortly beyond Zunac we finally emerged from the Amazon jungle at the foot of lofty cliffs up which two hours of climbing brought us to two lakes, Colay and Moctatlan, 12,000 feet above sea level, situated on the treeless *páramo*. We were at last on top of the Andes with snow-capped peaks about us. From this point we descended on horseback the Chambo valley to Riobamba, the end of our journey.

## Summary of Topography

Some of the outstanding facts of the foregoing description may be briefly summarized.

In the Oriente the Amazon plain abuts abruptly against the base of the Eastern Cordillera of the Andes at elevations of 3800 feet near Mera, 3600 feet at Macas, 4100 feet at the base of the Cordillera Guacamayo—in general 4000 feet above sea level. Thence it slopes gently eastward, descending in a distance of 70 miles to a surface about 1000 feet above the sea at the mouth of the Rio Coca. Only a few relief features break the evenness of this surface: the Cordillera Guacamayo in the north with summits about 9000 feet above the sea; the Cordillera Galeras north of the Rio Napo, probably a residual range, whose summits reach 6000 feet; and, most striking feature of all, Mt. Sumaco, the great cone-shaped peak east of the Cordillera Guacamayo whose summit is 12,700 feet. The valleys have a maximum depth below the upper surface of 1000 feet, with interstream areas several miles wide. The rivers are all swift, torrential streams, navigable, if at all, only for Indian canoes, until they change to deep, sluggish, wide, muddy streams navigable for small steamers.

## Climate

The limited time spent by us in the Oriente—four months, August to November—does not permit the formation of conclusions regarding climatic conditions through the year. It may be remarked, however, that tempera-

ture in the Oriente has a very small range, daily and annually. Rainfall, as well as altitude, affects the temperature, districts like Mera in the belt of maximum rainfall being cooler than corresponding elevations farther east.

There is a pronounced difference in the rainfall in the Oriente. The trades coming from the southeast are drying as they ascend the Rio Napo, but upon reaching the wall of the Andes and rising suddenly from 4000 to 18,000 feet they are suddenly cooled and give up their moisture. The belt of maximum precipitation in the region described in this paper lies approximately between the levels of Mera (3800 feet) and Baños (6000 feet) where it rains nearly every day. Below 4000 feet the rains were moderate at the time of our visit. It is reported that the months of September and November are the driest of the year. We have no records of actual rainfall in the Oriente except for Puyo, a few miles east of Mera, i. e. close to the belt of maximum rainfall at 3200 feet elevation. Martinez gives the following record for four months, year not stated: December, 8.7 inches; January, 12 inches; February, 18.4 inches; March, 13.7 inches. The annual total on the basis of these figures would amount to 150 inches. It is not surprising that there are fewer Indians living in the vicinity of Mera than eastward in the drier region about Canelos and Napo.

It was noted early in our work that barometric changes were very constant. Humboldt was the first to call attention to the uniform variation of atmospheric pressure in the equatorial regions of South America. He said that the time of day could be told by a barometric reading. High barometer is found at nine in the morning and low barometer at four in the afternoon. This was true every day regardless of the weather. However, when the pressures for several days have been plotted, the curve for a clear day will be approximately parallel with but above the curve for a rainy day. Nearly every day the afternoon low barometer was followed by rain which often lasted into the evening. Our barometric observations were taken in feet of elevation and were plotted showing the variation at Napo, Canelos, Alapicos, Macas, and intermediary points. These curves were very similar, and, after finding the law of variation, a correction table was made which was used throughout the survey whenever elevations were recorded.

## Magnetic Declination

At all important stations the magnetic declination was determined. In every case the compass needle pointed east of the true meridian. The declination for the chief localities was thus: Napo, 5° 43′ E.; Tena, 5° 43′ E.; Canelos, 5° 45′ E.; Alapicos, 6° 14′ E.; Macas, 6° 19′ E.

## Animal Life in the Jungle

While the purposes of the expedition were essentially geological and geographical, some notes may be made on the wild life of the region. While descending the Pastaza from Baños to Mera heavy rains prevented us

from seeing more than an occasional bird. On the trail from Mera to Napo we first saw tracks of the tapir, which is the largest animal in this region. Around one of the camps at night a crashing of small trees and branches was heard. Inquiry among the carriers brought forth the information that a herd of tapirs was passing. Our first glimpse of this creature was when the Indians chased one into the Rio Napo below Venecia and speared it with wooden lances. They were so anxious to get at the meat that in a few minutes they had the carcass dismembered on the beach. It was as large as a small horse, probably weighing over one thousand pounds. The Indians gave us one of the quarters, but we found the meat tough. They, however, had a great feast on it. Tapir trails which we saw later were always in bottom lands near streams.

Deer tracks were observed throughout the region, and an animal was occasionally seen. They were dull gray in color and of good size. So much noise was made in the progress of our survey that it was impossible to get near them. This was true of many other animals. We saw the tracks and wallows of wild hogs but never came upon the animals. They are hunted by whites and Indians for their meat.

Two river animals which we saw were called by the natives *huanta* and *huatusa*. They are three-toed, tailless rodents with small front legs and powerful hind legs. The *huanta* is the larger, weighing fifty pounds or more, while the *huatusa* averages ten or fifteen pounds. Both are prized for their meat.

The one species of monkey encountered had a smooth black face and dark red fur and averaged perhaps thirty pounds in weight. We saw them first along the Anzu River above Napo and again on the trail from Napo to Canelos. The Indians and whites hunt them for food.

Our Indians shot two tree sloths near Canelos. They were shaggy, gray-green animals slightly heavier than the monkeys. They live entirely in the trees and because of their protective coloring and slow motions are not easily detected. Their green coloring is due to an organism which grows on the hair.

Another tree animal, the night-foraging honey bear or night monkey of the natives, was present around all our camps. His sharp, little, squeaky whistle was heard many nights before we learned the identity of the visitor. Our friends at Archidona gave us one which was quite tame. His sharp nose and long, ringed tail made him appear like the raccoon of our northern forests. The natives at Alapicos gave us the skin of an anteater, or ant-eating bear, which in size and color was like a small black bear. It has a long bushy tail of coarse excelsior-like hair.

Skins of jaguars, some of large size, were shown us in the towns; but we saw only an occasional track along the trail. The Indians of our party feared the "tigers," as they called them. It is probable that they are the most ferocious animals in the region.

Bats were common, and we slept under nets more as a protection from them than from mosquitoes. We saw horses and cattle which had been bitten by the vampire bat.

The Indians talked of snakes, particularly the water boa which haunts the rivers further east; but in our travels we saw none.

We were impressed by the almost total absence of birds from great jungle areas; day after day we traversed the trails seeing only a stray humming bird or hearing a pair of parrots scolding as they passed overhead. A kingfisher with a dull, orange breast was seen along the rivers, just as industrious and just as clattering as his northern brother. Toucans were sometimes seen in the jungle and around native houses, where they are kept as pets. Wild turkeys live along the smaller streams. On the lower Napo we saw a few condors. The Jíbaros around Macas showed us many small, highly colored birds which they shoot with blowguns. Most of these resemble orioles or finches. At Macas we saw for the first time swallows with black crosses on the under sides of their wings.

## Population

The Pastaza River is the dividing line between Indian tribes who speak different languages. The Quechua-speaking Indians live north of the river and are known as "Napo" Indians, "Canelos" Indians, etc., according to the name of the white settlement near which they reside. A characteristic of these Indians, as well as of the Jíbaros further south, is the fact that they have no villages. They live along streams, each family separated from the next. Near the white settlements, however, their huts, while continuing to be hidden in the jungle, are closer together. At Canelos, for example, the village consists of two or three houses of whites; not an Indian is to be seen. But on following dim trails radiating out from the settlement the homes of the Indians will be found. This lack of community life carries with it a corresponding lack of social organization, and, although there are chiefs, they are individuals who exercise only vague authority. The Indians for the most part are under the patronage of whites, whom they call "patrons." Each white man exercises a sphere of influence over as many Indians as he can, and the rivalry between white men is rather keen, bitterness arising in case of conflict over the patronage of Indians. In return for the protection offered by the white the Indian will now and then do some work, especially in carrying supplies to and from Quito or in washing gold from stream gravels. The number of Indians is small, and it is difficult to induce them to work. The use of Indian labor to any large extent is, in the writers' opinion, out of the question; construction of railways, pipe lines, highways, etc., will have to depend on white labor brought down from cities, such as Baños and Ambato, and in all probability on labor imported from the West Indies or some other region, as was done during the construction of the Guayaquil and Quito Railway.

The Jíbaros south of the Pastaza hold no allegiance to white masters and are in many ways superior to the Quechuas. They have strong, clean bodies and intelligent faces. They go armed with the deadly blowgun and long lances bearing iron heads. The men weave a good grade of cloth made from homespun cotton. They build strong houses of hard black palm, for each family is a unit and the house is a fort as well as a home. Sometimes twenty or thirty people live under one roof. They have gardens of yuca, plantain, papaya, and small red peppers. Polygamy is practiced. The name headhunter is applied to them from their practice of reducing the heads of enemies. These are used in ceremonial dances and for personal adornment. A great deal of the fighting between families is due to the witch doctors, who are called in to determine who has bewitched a sick person.

The Jíbaros who gathered at Alapicos to look over our outfit came from curiosity. They were not disposed to work, and we had nothing in the way of cloth or trinkets which would induce them to carry loads to Macas. They became interested when they learned that our guide had two small, stone jars of the black poison which they prize so highly for their blowgun darts. This poison is brought into the country by Indians from northern Peru where the secret formula is known. Our guide, Sr. Rivadeneyra, had obtained the poison from an Indian just as he arrived from Peru. The Jíbaros carried our equipment to Macas, a trip of eight days. Each Indian received about a teaspoonful of the black, sticky poison and felt well paid.

The white inhabitants are Spanish-speaking people who have migrated from the highlands of Ecuador. One of the striking features of these people is the fact that, though situated among Indians, they have preserved their purity of race. The total population of whites in the region from Archidona to Macas cannot exceed 600, and almost all of these are living in the town of Macas. This town is a unique settlement, located at an elevation of 3580 feet above the sea, distant eight days from the upland civilization by the most difficult travel on foot, in mud, and up mountainous cliffs. It is a town of perhaps 100 houses and nearly 500 people, cut off almost entirely from the civilization of the upland. Without commerce and communication, one wonders why this or any of the other such settlements continues to exist; yet their history dates back to the early settlement of South America by the Spaniards. Perhaps it can be explained by healthful conditions and the agricultural productivity of the region.

The great drawback of civilized development in eastern Ecuador is the lack of railways. The future depends on one thing, the continuation of the railway from Pelileo down the great natural gateway to the Oriente, the Pastaza River, and on the construction of branches north and south along the base of the Andes from a point like Mera. The Upano Trail and the Papallacta Trail are impossible routes of communication, being unfit for highway or railway construction.

78°30′ 78° 77°30′ 77°

0°30′ 1° 1°30′

ANTISANA
18880 FT.

CORDILLERA GUACAMAYO

COTOPAXI
19493 FT.

CERRO SUMACO
12700 FT.
ELEVATION AND
GEOGRAPHICAL POSITION
BY SINCLAIR & WASSON

CORDILLERA GALERAS

RIO COCA

RIO PAYAMINO

850

RIO SUYUNO

RIO HUINO

RIO SUNO

RIO JANDACHI

RIO HOLLIN

Archidona 2000

RIO TENA

RIO MISAHUALLI

Tena

Napo 1680

RIO ANZU

RIO ILA

RIO ARAJUNO

RIO CURARAY

RIO VILLANO

AMBATO

8488
Pelileo

6014
Baños

RIO TOPO

TUNGURAGUA
16684 FT.

Mera
3808

Puyo

RIO BOBONAZA

Indelyama

Canelos
1690

RIO PINDO

ALTAR
17725 FT.

# Explorations in EASTERN ECUADOR in 1921 by Joseph H. Sinclair and Theron Wasson

MILES
5 0 5 10 15 20 25
(APPROXIMATELY 1:500,000)

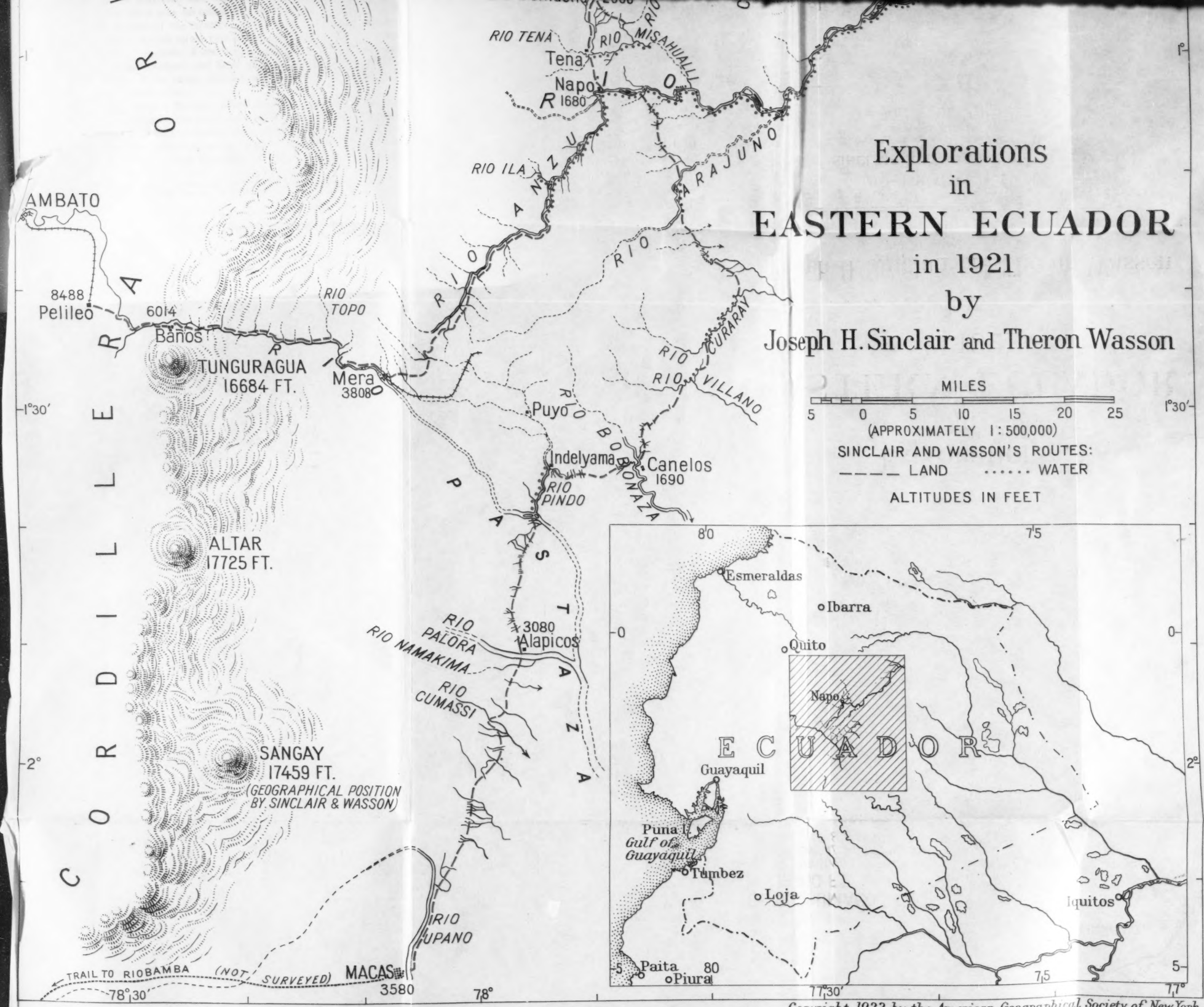
SINCLAIR AND WASSON'S ROUTES:
____ LAND ..... WATER

ALTITUDES IN FEET

8°0 7°5

Esmeraldas

# Explorations in EASTERN ECUADOR in 1921 by Joseph H. Sinclair and Theron Wasson

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The Geographical Review, Vol. XIII, No. 2, 1923, Plate IV

# THE SAPO MOUNTAINS AND THE SAMBÚ VALLEY

## A BIOLOGICAL RECONNAISSANCE IN SOUTHEASTERN PANAMA

By T. Barbour and W. S. Brooks

Southeastern Panama is not easy of access. Regular communication between the city of Panama and Darien ceased some years ago with the closing down of the gold mine at Santa Cruz de Cana. This famous old mine, the source of "infinite wealth" in earlier colonial days had been reopened towards the end of the last century, and while it was in operation there was steamboat service between the capital and the chief settlements—the village of Yavisa on the Rio Chucunaque and El Real de Santa Maria and other small towns on the Rio Tuyra. From Marragantí, the head of steamboat navigation, canoes were taken for Boca de Cupe, whence a small railway of sorts extended forty miles to the mine.

Today communication with the exterior is generally limited to the great *carricaballo* dugout schooners which still bring bananas to Panama from the coast ports of Darien.[1] These vessels, however, sail very badly, are miserably handled, and make poor time on their coastwise voyages. Once in a while an auxiliary schooner makes a trip to La Palma at the mouth of the Tuyra estuary.

Nor is any amelioration in prospect. Since, owing to chicanery and bad management, the Cana mine has closed, the population of the Tuyra valley has dwindled. The constantly shrinking price of ivory nuts has also played its part in the economic decline of the region, making more miserable the unhappy lot of the scattered and neglected population of negroes and mestizos who form what may be called the Panamanian population of the extreme eastern portion of the country. The ruling classes who reside in the capital consider any visit to the provinces as arduous or even dangerous and have no desire to explore. Even within a few score miles of the canal locks at Gatun and Miraflores are large areas populated with primitive Indians and almost, if not really, less known than they were during the days of the early *conquistadores*.

To the biologist eastern Panama offers almost a virgin terrain. Only two parties of naturalists have previously worked here. E. A. Goldman, of the United States Biological Survey, with a Costa Rican assistant, spent some months of fruitful collecting on the slopes of Mt. Pirre and the headwaters of the Rio Tuyra, using the mines at Cana as a most convenient

[1] Compare T. O. Selfridge: Reports of Explorations and Surveys to Ascertain the Practicability of a Ship-Canal Between the Atlantic and Pacific Oceans by the Way of the Isthmus of Darien, Washington, D. C., 1874, p. 162.

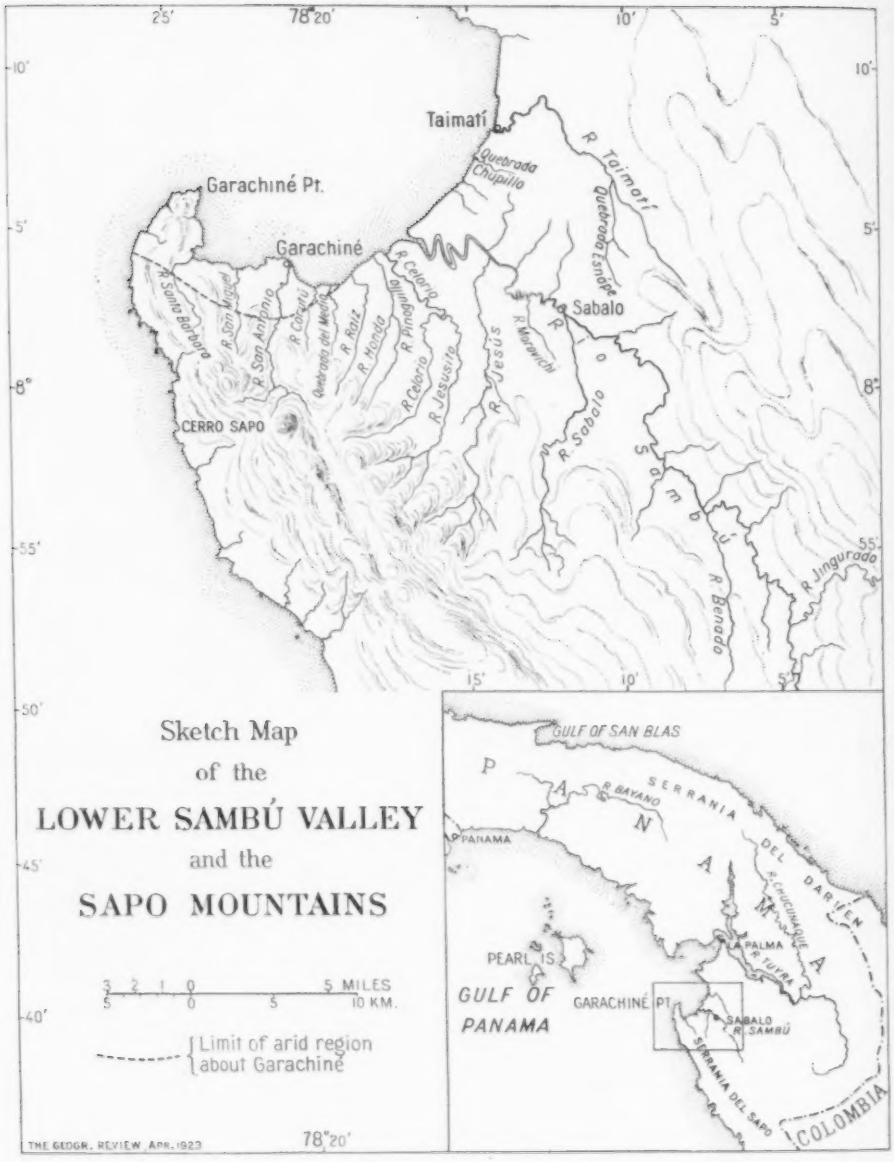


Fig. 1—Sketch map of the lower Sambú Valley and the northern part of the Sapo Mountains drawn from observations by the authors and data supplied by Colonel Morrell. Scale approximately 1:430,000. The general location is shown on the inset map.

base.[2] A little later a party from the American Museum of Natural History, led by the veteran W. B. Richardson, secured additional collections from the valley of the Chucunaque, reaching Mt. Tatarcuna on the summit of the

[2] E. A. Goldman: Mammals of Panama, *Smithsonian Misc. Colls.*, Vol. 69, No. 5, Washington, D. C. 1920. See abstract with map in the *Geogr. Rev.*, Vol. 10, 1920, pp. 267–268.

divide.[3] In the first half of 1922 the writers undertook a biological reconnaissance in the territory west of the Tuyra basin—in the valley of the Sambú and the Sapo mountains.

## From Panama to Garachiné

When we arrived in Panama in the month of March, we were discouraged to find that an opportunity to reach Garachiné, the village near the mouth of the Sambú River, without loss of time seemed very remote. After days spent in idle inquiry we received the news from our old friend Don Pablo Pinel that the auxiliary schooner *Chiriquí* had been chartered by the government for a trip directly to Garachiné itself. Thanks to the kindness of Dr. Porras, the President of Panama, whom we approached through Dr. R. P. Strong, Chief of the Gorgas Memorial Institute for Medical Research, we were allowed passage on this vessel. Her mission was to carry the Ministers of Interior and Finance to adjudicate disputed oil claims in the coastal region of the Gulf of San Miguel.

Sailing from Panama one afternoon we spent the night in our cots on the deck of the *Chiriquí*, waking only from time to time to watch the unrivaled phosphorescence for which the great Gulf of Panama is celebrated. At daylight we were off Iguana Island and by ten were at anchor off Garachiné. Garachiné has no harbor but nevertheless is well protected by the high and arid headland of La Punta de Garachiné. This point and the plain on which the town is situated lie in a small, isolated zone of very sparse rainfall, the moisture being precipitated from the trade winds by the high peak of Mt. Sapo proper (4000–5000 feet), the westerly outpost of the Sapo range, which lies about ten miles inland from the village. Mt. Sapo is covered with high rain forest which extends in all its luxuriant splendor over the whole Sambú valley and reaches the coast at the mouths of the Taimatí and Sambú Rivers but a few miles north of the semiarid Garachiné Point with its sparse, scrawny forest of white-barked *cuipo* trees.

We made no attempt to climb Mt. Sapo itself; but from a spur, called La Jarcia, above one of our camps (1700 feet) we got several splendid views of the range, which can also be clearly observed at times from the sea. It is our belief that, although the Cerro de Sapo is currently believed to be the highest point of the range, in reality there are several peaks which exceed it in height, lying some thirty or forty miles southeastward and not far from the Colombian frontier.

The village of Garachiné lies on a burning, treeless stretch of shingle, which at low tide is fronted by an enormous expanse of stinking mud flats. The town is ill-favored in the extreme, pestilential and half deserted. There are possibly three hundred inhabitants although, some say owing to a misconception in the capital as to its size, it boasts five schools which

[3] H. E. Anthony: Panama Mammals Collected in 1914–1915, *Bull. Amer. Museum of Nat. Hist.*, Vol. 35, 1916, pp. 357–376. See the striking photograph of the forest-clad Mt. Tatarcuna (*not* Tacarcuna), Figure 1.

function intermittently. To one familiar with village life or architecture in Panama, Garachiné presents no novelty or attraction, and we were not sorry to embark our equipment in the little launch, which we had towed from Panama, and start for the Sambú. The launch took us to the head of navigation, dropped us ashore, and returned at once to Garachiné and Panama.

### The Sambú River

The lower reaches of the Sambú are flanked by high mangrove forests which gradually give way to a varied growth of hardwoods as the banks rise slightly higher. As on the other rivers draining the Pacific slope of eastern Panama, the great rise and fall of the tide is felt many miles inland and really controls possible navigation. We steamed up the river on the swiftly rising tide to the head of navigation at the junction of the Sabalo with the Sambú, where we disembarked our gear.

The main stream of the Sambú has been ascended by one or two white persons as far as Boca de Sabalo and once, by Major Maulsbury of the Canal Zone Survey, to the Rio Pavarondó. His object was to fix certain points for the Panama Gulf Oil Company, and we owe to Colonel Morrell of that company the opportunity to use these fixed points and other data in preparing our sketch map, which shows at least approximately the true relations of the Sambú tributaries with the Sapo range—relations which on previous maps have been very incorrectly drawn. Except for these journeys on the main stream of the Sambú there seems to have been no exploration by white men of the affluent rivers and the Sapo hinterland.

### Synopsis of the Trip

Our purpose was zoölogical, not geographical, exploration; so that the intimate details of our work day by day need not be dwelt upon. Suffice it to say that we made our first camp on the Quebrada Esnape, a tributary of the Rio Taimatí, several hours' march northeast of Boca de Sabalo. Here we spent several days; but, finding the rainfall excessive and reptiles very scarce, we retraced our steps and marched from the Sabalo mouth across to the upper reaches of the Rio Jesús—a long, arduous tramp through dark, stifling, and very boggy forest. From the house of the Indian Churima, where we passed the night, we marched to the Rio Jesusito and then by stages ascended this stream to where it entered a wide gorge in the Sapo range. We made excursions in various directions using our upper Jesusito camp as a base. Our next move was to return to the house of Churima on the Jesús and then take dugouts and descend the river—a long day's drag and paddle—to the junction of the Jesús and the Sambú; here, caught by night, we were forced to camp in the low forest, muddier even than elsewhere. The following day we reëntered Garachiné, paid off our Indians, and engaged a crew of Panamanians—most worthless fellows; with them, or rather in spite of them, we managed to move our equipment up the valley

of the San Antonio to the lower slopes of Mt. Sapo. From this camp we made excursions in various directions and finally, our provisions having again run short, returned to Garachiné and chanced to find a small 22-foot

FIG. 2—A pure stand of ivory nut palms on the slopes of Mt. Sapo. This hillside could be ascended only by proceeding on "all fours" and pulling oneself from tree to tree.

gasoline launch, belonging to an itinerant official. Chartered at an exorbitant price, this leaky and wholly unseaworthy craft finally brought us to Panama again. This journey was the most dangerous feature of the entire trip.

## The Chocoano Indians

Perhaps the most valuable advice received on our trip was that given us by Major Maulsbury when he said, "Keep asking for the Indian Juicio; he talks Spanish and is wholly reliable." We began to encounter the naked Indians working in their clearings along the Sambú, beginning perhaps ten miles from its mouth. They were decidedly undemonstrative at the unaccustomed sight of our launch and paid little heed to our shouted messages. However, Major Maulsbury, who was in the launch, was recognized. He was much beloved by the Indians, and we had not been many hours at Boca de Sabalo before Juicio stepped into the circle of our firelight with four of his friends.

Contrary to the many stories we had heard, we found the Indians not only friendly, after the ice was once broken, but honest, industrious, and wholly interested helpers. Several became most trusted advisers and friends. In all respects the Indians proved a marked contrast to the shiftless Panamanians who presume to despise them.

The Indians of eastern Panama belong to two groups, the Cuna Indians, who live along the Darien divide and who inhabit part of the Caribbean littoral—the San Blas coast, for instance[4]—and the Choco, Chocoi, or more correctly the Chocoano, Indians.[5] These two peoples have managed to persist uncontaminated to this day by different but equally successful means. The Cunas have been bold and ferocious warriors and still forbid whites from ascending the Chucunaque beyond the mouth of the Membrillo. It is probable, however, that a party of Americans could go anywhere in this territory, given a little time to establish relations. The Chocoano people extend over a larger area and have survived by retiring before any visitors and living in their forest fastnesses far from outside contact. They, nevertheless, used their arrows, poisoned with the skin secretion of a venomous tree frog (*Dendrobates*), to good advantage. Today many possess antique firearms and are ashamed to confess that they own a bow and arrows, although actually these are still in use.

It is impossible to estimate the number of Chocoans in Panamanian territory; they occupy a portion of the Colombian territory of the Choco as well. Their houses are not grouped in villages but are scattered, always on some river or stream bank, throughout not only the whole Sambú and Taimatí valleys but also on many of the other rivers as well. They have no permanent habitations in the Sapo highlands and go there only to make canoes or to hunt.

## Their Houses and Method of Life

Their houses are in general similar in type. Placed on posts about five feet from the ground, the floors are made of the split trunks of the Iriartea

[4] Compare S. P. Verner: The San Blas Indians of Panama, *Geogr. Rev.*, Vol. 10, 1920, pp. 23–30.

[5] The Panamanians speak locally of "Cholos Chocoanos," "Cholo" being the local word for Indian and having a different significance from the Bolivian usage.

palm; and the roof, sloping four ways from a ridgepole some ten or twelve feet in length, is of palm thatch. The space under the roof and well above the heads of the occupants is devoted to the storage of domestic articles and dancing and hunting gear. There are no walls. A notched tree trunk serves as a stairway. In one corner a square of four logs filled in with packed clay serves as a fireplace. The firewood is always laid on end to end,

FIG. 3

FIG. 4

FIG. 3—A Chocoano Indian. One of our most trustworthy hunters before a temporary shelter on the lower Rio Jesusito.

FIG. 4—Chocoano Indians. Our friend Churima, his wife, and children.

and the point of juncture of the six or eight sticks thus gradually being consumed serves to support the large earthen pot in which the cooking is done. Green bananas are roasted by removing the peel and standing them upright in the embers. They are scraped before being eaten. The Chocoans make excellent pottery of varied forms. Their basketry exhibits much originality of design and shows a knowledge of many types of plaiting and weaving.

Groves of banana plants surround all their dwelling places and grow with splendid luxuriance. A little maize and a little upland rice are cultivated; but in general bananas, boiled or roasted and always cooked green, together with game and especially fish form their staple food. In fishing the Chocoans

use a long lance of beautifully polished palm wood and spear the sluggish catfish which swim near the surface of the deep, muddy streams. In the swift, clear waters they hunt the fish which lurk among rocks or in holes in the banks, using a knife to cripple them. Since firearms came into use, game has become scarce. The condition of mammals brought to camp gave every evidence that the hunters approached to within a very few feet of their quarry. Being more used to bows than firearms, the hunters hold the rifle or single-barreled shotgun in an unusual manner. The left hand, holding the grip and trigger, is extended at arm's length; the right hand, grasping the butt plate, takes the recoil. Possessed of great skill in woodcraft, wonderful vision, and almost unbelievable endurance, the Chocoans are rapidly reducing the numbers of tapir, deer, and peccary. However, they eat any mammal down to the size of a rat and many birds, so that they have a varied diet.

## Their Customs and Habits

The men wear a narrow loin cloth and show great fondness for bodily decoration. A wild fruit, the annatto, having a carmine juice, is used in conjunction with soot; and face, body, and thighs are elaborately decorated with stripes and lattice designs in red and black. After the invariable morning bath—the men swim fully as well as Polynesians—fresh orchids or some other conspicuous flowers are stuck through the lobes of their ears, and pollen and loose flower leaves are sprinkled on their heads. The nature of our work prevented our observing the natives in ceremonial attire or during festivities. Their hair as a rule was cropped, although this appears not to accord with Mr. Pittier's observations.[6] The Chocoans are short in stature—from five feet, three inches to five feet, seven inches in height; but they are well built, graceful, and lithe. No old men or old women were seen.

The women are well treated but are rather kept in the background until one is on terms of intimacy with the men folk. They are clean and well formed and wear a single narrow skirt. They were never observed to paint their faces or bodies, although we were told that they do so for feasts and dances. Mr. Pittier states that the women of this tribe preserve their "good looks" longer than most primitive women. The impossibility of ascertaining their ages renders statements of this sort very vague. The children are loaded with beads and of course usually wear no clothes until well grown. Children are numerous, and all appear well nourished. Their hair often presents a rusty appearance not seen in the adults. Apparently the whole Chocoano population has a high immunity to malaria, although at present a few suffer from the local relapsing fever. Since they scrupulously avoid contact with the Panamanians there is little or no venereal disease.

[6] Henry Pittier: Little-Known Parts of Panama, *Natl. Geogr. Mag.*, Vol. 23, 1912, pp. 627–662; reference on p. 659.

FIG. 5

FIG. 6

FIG. 5—Indian house in a plantation of bananas on the Rio Sambú.

FIG. 6—View of the summit of the Cerro de Sapo from a clearing made on the neighboring ridge La Jarcia. Looking west-southwest.

## Sanitary Precautions of the Expedition

The lowlands of the whole Darien region are notoriously unhealthful, and, as we suffered no ill effects from our sojourn, a few words as to our equipment may be of interest. Our drinking water was all purified in a forty-gallon Lister bag obtained through the kind interest of Dr. Strong

Fig. 7

Fig. 8

Fig. 7—The extreme headwaters of the Río San Antonio. This photograph was obtained by a twenty-one-second exposure on a cloudy day.

Fig. 8—Vegetation in the lowlands of the Sambú. An abandoned Indian plantation.

and Major Bocock of the Army Medical Corps. Our open-front tent had a mosquito curtain drop in the doorway, which was considered sufficient protection when we were camped far from human habitation and where the mosquitos were probably not infected. The period of metamorphosis of the parasite in the salivary gland of the mosquito is ten days, so that mosquitos becoming infected, as they undoubtedly did after biting our carriers, would become capable of transmitting malaria in that time. We therefore moved camp several miles at least every ten days. We had spe-

cially made mosquito bars for use over our cots when sleeping in native huts or in our forest huts, for we ordinarily used the tent to keep our powder, food, and specimens dry. These mosquito bars had balloon silk waterproof tops which extended down about four inches on the sides; below this was sewed a zone of heavy bobbinet; and below this was a wide strip of heavy unbleached muslin with a deep hem. A light floorcloth prevented the entrance of mosquitos from below when we were in a cane-floored hut. In the woods we ran a heavy pole through the hems of our *mosquiteras* which kept them close to the soft ground. Anopheles begin to fly at dusk, so that we habitually ate an early supper and then got under our mosquito bars to put in an overlong night, rendered doubly tedious by the stifling heat within the bar. At daybreak we waited until we observed that the Anopheles resting on the bobbinet had all flown away, and then we emerged. We followed this very uncomfortable and perhaps over-cautious régime without exception, even where we believed the mosquitos were not infected. About our highest camp on the slopes of Sapo there were no Anopheles, and we smoked our after-supper pipes out of doors in great enjoyment. One point in setting up the mosquito bar is of prime importance. It should flare as widely as possible when hung, in order to lessen the probability of the sleeper's moving during the night so that arms or feet come in contact with the net and thus permit the Anopheles to bite through the mesh.

## Food Supply

We carried Burroughs and Wellcome tea tablets and many types of dehydrated and compressed food, which served excellently well. We were unfortunate, however, in finding that our Indian companions were short of food themselves. Disastrous floods before our arrival had played havoc with their lowland plantations. To persuade them to carry for us, when in reality they wanted to replant, it was necessary for us to share our food with our large party. This resulted in our running very short while on the upper Jesusito where we found large game much scarcer than we had expected. Our Indians stood by us loyally, for usually they do not travel in such large companies; but for a long time afterward we felt the ill effects of a diet of green bananas and such rat and monkey meat as we were able to procure. The extreme heat and constant rain made it almost impossible to keep venison and wild pork from spoiling, although we carried a hundred pounds of salt. In any case meat never lasted long, since, when deer or peccaries came in, the Indians ate enormously and considerately sent salted meat by a runner to their wives at home.

## Vegetation of the Region

The climate of Darien approaches that of the western Colombian region (Chocó) of very heavy rainfall.[7] The forest throughout the Sambú valley

[7] Compare Goldman, *op. cit.*, p. 22, "In much of the Darien region the total rainfall is increased to an annual precipitation of perhaps more than 200 inches, which renders this area one of the wettest in America."

is of the heaviest rain-forest type, high, deep, and dark. Wherever the light penetrates, as along water courses, there is abundant growth of scattered palms of many species. Within the density of the high woods the *palmae* are less conspicuous although they are to be found everywhere. Over large areas of bottom land and along steep, sharp ridges as well, great areas of ivory nut palms occur almost always in clear stands unmixed with other species. The ivory nut palm (*Phytelephas*)—locally called *tagua*, and the groves *taguales*—grows much more luxuriantly in the wet lowlands than on the better-drained slopes and makes a dark, gloomy wood, the floor of bare slimy mud with molds growing actively except where the rain often floods the forest floor. The *monte alto*, as the deciduous woods are called, is hard to penetrate not because the dense undergrowth cannot be avoided—for it can, as it grows only where light penetrates—but because the tree trunks are close together and the great vegetable hawsers of tangled *bejucales* run up and down and from tree to tree in unbelievable confusion. They form the usual highways for monkeys, squirrels, many other small rodents and many creeping birds—far safer than the ground.

The forest along the Jesusito is the finest we have ever seen, finer than may be seen in Java, the Moluccas, Papua, or the Organ Mountains of Brazil. We cannot compare it with the great Amazonian or the Congo forests; but, while it is of far smaller extent, we cannot believe that it is not equally high and varied. As is usual, the green forest roof is overtopped by isolated giants which, when they happen to be of flowering species, stand out in gorgeous contrast to the wide roof of varied green. Our lookout, cleared on one of the elevated spurs of Mt. Sapo, revealed many vivid species in flower. The Sapo range, as has been indicated, cuts the moisture-laden winds off from Garachiné and its sheltering peninsula, and here the vegetation is semi-xerophytic and in striking contrast to the region inland. The point of Garachiné is covered with open woods looking quite white from a distance since the white-barked *cuipo* trees (*Cavanillesia*) abound to the exclusion of most other species. About the town itself there is some pasturing of cattle, and in the pasture lands acacias remind one of the *potreros* of Cuba.

# THE LAPPS IN SWEDEN

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From early times two essentially different peoples, different in origin, in language, and in civilization, have lived side by side in northern Sweden—the Swedes and the Lapps. Reasons for conflict have not been wanting, naturally, between these two peoples; but at the same time, with some rare exceptions, these conflicts have not been so acute and tragic as in the majority of similar cases in other parts of the world. During the course of time agricultural, and latterly industrial, penetration has carried the Swedes far up into the country of the Lapps; and, strange as it may sound, the Lapps also with their reindeer have penetrated far into the ancient territory of the Swedes. As to culture, naturally it is the Swedes who have been the givers; but the Lapps, although they have adopted much from modern civilization, still contrive to retain at least the material side of their own old culture. The Lapps are now and have been for hundreds of years good Swedish citizens and fully conscious of their Swedish nationality. For instance those Swedish Lapps whose wanderings take them for a part of the year into Norwegian territory always call themselves "Swedes." However, the indebtedness is not all on the side of the Lapps. The Swedes are and long must be dependent in some important respects upon their weaker Lapp brethren and their work.

Fig. 1—Old Lapp. This and the following photographs are from Jukkasjärvi and Karesuando, the most northerly parishes in Swedish Lapland.

## Origin of the Lapps

Anthropologically classification of the Lapps is doubtful. It is usually said that they are "Mongol" or "Mongoloid;" but little is gained by this term, because there is no certainty that there is or ever has been a "Mongol race."[1] At present one can only say that the Lapps, where preserved in comparative purity, are a people distinguished by short stature, very brachycephalic heads, light complexion with somewhat of a yellowish brown

[1] Recently an interesting attempt has been made by H. Bryn to group the Lapps and the Samoyeds together as a Palearctic race, *Ymer*, Vol. 22, 1922, p. 350.

tint, brown eyes and dark or quite black straight hair. The face is very broad, the chin often poorly developed; but the eyes are not "Mongol," i. e. oblique. Physically the Lapps are thus sharply differentiated from both the Scandinavians and the Finns. Temperamental differences are at least as marked, even if these are less easily defined. The Lapps, however, like the Finns speak a Finno-Ugric language. At some time, certainly more than 2000 years ago, they perhaps adopted it from a neighboring superior Finno-Ugric people, presumably the forefathers of the Finns of the present day; but during the ages intervening the languages of Finns and Lapps have developed along such different lines that mutual understanding long ago became impossible. The Lapp language has furthermore developed into a large number of different dialects so specialized that they too, to a large extent, are mutually incomprehensible. At the present time,within the borders of Sweden alone, the several dialects may be considered as constituting three different languages. When Swedish Lapps from more distant districts meet, they use Swedish as the medium of communication.

It is not known what language the Lapps spoke before they adopted their present vernacular, and therefore it is not possible to show by linguistic means their anthropological affinities. All that is certain is that they immigrated to the Scandinavian peninsula from the northeast and that before they did so they were to be found as far south as central and southern Finland and in the neighboring parts of Russia, even as far as the great lakes Saima and Onega. From whence they had come to these last-mentioned districts is not known. Probably, as primitive hunters and fishermen, they had followed the inland ice as it shrank northward, but whether they pushed forward from the southwest, from the south, or from the southeast is not known.

## Lapp Migrations into the Scandinavian Peninsula

From the earliest times the reindeer has played a vital part in the Lapp economy, at first as the chief game hunted, later under domestication. Taming of the reindeer seems to have begun only when the Lapps had reached the mountain districts in the northernmost parts of Finland and Scandinavia. At first, it appears, the tamed deer were used for bearing burdens and drawing sledges, work previously done by human power, perhaps with the help of dogs. Later, small herds were formed and maintained as a food resource. Use of reindeer milk and method of milking were evidently learned by the Lapps from the Scandinavians. There does not seem to have been any direct connection between the Lapp method of reindeer management and that obtaining in Siberia, the westernmost offshoot of which is found among the Samoyeds on the tundras of northeastern European Russia.[2]

The date of the first contact of Lapps and Scandinavians has been estab-

[2] On reindeer culture among the Samoyeds and other Siberian tribes see H. U. Hall: A Siberian Wilderness: Native Life on the Lower Yenisei, *Geogr. Rev.*, Vol. 5, 1918, pp. 1–21.

lished by linguistic means. It took place about the middle of the millennium preceding the Christian era and presumably in the most northerly part of what is now Norway. Knowledge of iron and its use had just reached these northern districts, and the Lapps learned both name and usage from the advancing Scandinavians. From this time onward a great number of other culture elements, material and mental, began to pass to the Lapps from their new neighbors and were evidently accepted by them with avidity. The old Scandinavian names for all these elements, preserved by the Lapps with admirable fidelity, bear witness to these movements. Other testimony to these cultural relations is found in the ancient pagan religion of the Lapps which, according to sources dating from the seventeenth and eighteenth centuries, had early absorbed a great many ideas from Scandinavian paganism and later on from Christianity.

During the course of time their migrations carried the Lapps and their reindeer herds farther and farther into the Scandinavian peninsula. Along the mountains and through the great forests of the interior they moved progressively southward. At about latitude 66° N., they seem, even before the time of the Vikings, to have had occasional encounters with a presumably sparse Scandinavian population which then inhabited this region but which afterwards for some unknown cause moved away. During the Middle Ages the Lapps reached the 65th parallel. In the sixteenth century they began to appear in the mountains as far south as 64° and in the next century 63°, even in districts which had long been inhabited by a Swedish peasantry. Occasionally single families would be seen as far as 62°; but the Lapps and their herds did not obtain a permanent footing so far south until about 1880.

### The "Mountain" Lapps and Their Migrations

The nomadic, or so-called Mountain Lapps, who during the summer are to be found with their reindeer on the treeless mountains in the west, during the autumn move down to the forest districts in the east, where the reindeer find the lichen, reindeer moss. This is their principal winter food: in the summer their chief fodder consists of certain species of grass and of leaves. Actually, following the lay of the land and the course of the rivers, this yearly migration is a movement back and forth between northwest and southeast. In the southeast the Mountain Lapps in some districts come in contact with the so-called Forest Lapps, whose reindeer are of another race than those of the Mountain Lapps and who stay in the forests the whole year round. While the chief occupation of the Mountain Lapps for ages has been management of the reindeer, Forest Lapps were formerly chiefly employed in fishing and hunting. Latterly this has been considerably altered. In some cases their small reindeer herds have increased; in others agriculture has become their chief occupation. In many districts they have given up reindeer breeding entirely and have become peasants or have succumbed to poverty and disappeared.

Apparently in early times, before reindeer breeding had reached any great development, the Lapps were divided into small tribes whose territories were defined by natural boundaries from those of neighboring tribes. These territories in turn were divided into smaller tracts, to which the several families composing the tribe had exclusive rights. The whole of the tribe would gather together during midwinter at a more or less fixed center; but during the rest of the year the different families lived dispersed, each beside its own fishing waters and on its own hunting ground. Capturing of the wild reindeer, i. e. the principal form of the hunt, was carried on collectively and communally; otherwise, as a rule, every family fished and hunted on its own account. But with the development of mountain reindeer management things became more complicated. In certain mountain tracts, for instance, it was difficult to maintain any division into individual districts for reindeer breeding, and it also soon became necessary, owing to the increasing size of the herds, for the Mountain Lapps to extend their winter ranges. These, however, were already occupied by other Lapps, the forefathers of the Forest Lapps, whose mode of life seems to reflect an earlier period in the history of this people. The Mountain Lapps were thus compelled to rent grazing land for their herds with the Forest Lapps and at last to seek more land beyond the territory of the Forest Lapps and even to make furtive occupation of forest districts settled by Swedish peasants in the coastal regions. The result was a movement towards the coast in the southeast as well as along the mountain ridges towards the south. All this is in direct opposition to the commonly held supposition that the Lapps were the original inhabitants of large parts of Sweden and that they have been driven towards the north and west by the advancing Swedes. Presumably it is only north of the 65th parallel, where certain special local names point to an original Lapp population probably of the fisher and hunter type, that one can say they have been driven back from the coast.

The present eastern boundary of the province of Lapland which was fixed about 1750 A. D. shows a limit which the Lapps with their reindeer herds could only transgress in secret. Since then, however, they have succeeded in gradually pushing their way east of this boundary during the winter as far as the coast from Luleå to the south of Sundsvall, between 65° 30′ and 62°, where they have won a prescriptive right of occupation during the winter season. It is in fact a remarkable example of how a nomad people, almost in our own times, can under favorable circumstances push its way into the midst of an agricultural community.[3]

## Political and Legal Status of Lapland and the Lapps

For long the great wastes of the north were considered by the Swedish crown as *res nullius*. During the sixteenth century some attempt was

[3] An example analogous, in a way, of the capability of a nomadic mountain people to push its way forward to great distances and, as we may say, to filter through territory belonging to other nations, is to be found in the advance of the Rumanians in the Carpathians as far as Wallachisch-Meseritsch in Moravia, and in the Balkan Peninsula into northern Greece.

FIG. 2—Sketch map showing grazing lands of Swedish Lapps at various seasons of the year. Scale of map approximately 1:9,500,000.

made to fix the status of these lands as the property of king and state, a status that was definitely established during the following century, since when the Lapps as a matter of fact have only possessed the right of use and not of ownership of their country. From the end of the seventeenth century inclusive, with the advance of cultivation in Lapland, this situation became of great and decisive consequence for the Lapps, as the crown, especially in order to support the important mining industries which had arisen here and there in the mountain districts, encouraged the creation of new settlements. At the same time care has been taken, in practice as well as theory, that the Lapps shall be disturbed as little as possible. The settler must look after his own farm, and he is given only such forestry and fishing rights as are strictly necessary. Furthermore, many Lapps become settlers. With the consent of the authorities, and after individual investigation of each case, they can settle down like the Swedes and cultivate the soil within their prescriptive lands.

During the second half of the nineteenth century, owing to increasing cultivation, the Lapps began to be more and more cramped for room. Gradually, almost imperceptibly, important pasturage became difficult of access or useless to them. Reindeer damage the meadows and hay of the settlers; they also do a good deal of injury in the forests, a consideration of importance as the value of the forests increases. Difficulties soon began to arise, moreover, in connection with certain of the Swedish Mountain Lapps' ancient and prescriptive right of moving to territories which now belong to Norway or Finland.

In early times the country of the Lapps was *res nullius* to the extent that no foreign ruler had made any claim upon it; but already, during the times of the Vikings, the Norwegians had begun more or less systematically to collect "taxes" from the Lapps in what is now northernmost Norway and among the mountains lying about its borders. Not long after, perhaps simultaneously, Finnish trading companies on the shores of the Bothnian Gulf had settled at the mouths of the Kemi, Torne, Lule, and Pite Rivers, whence they began to exploit the hinterland and to collect "taxes" on behalf of themselves or the Swedish crown. The wanderings of the Mountain Lapps, however, continued and were directed as before by the instinct of the mountain reindeer, which led them during the summer to the grass-covered and mosquito-free mountains on the present Swedish-Norwegian boundary or, in certain districts, to the shores of the Atlantic Ocean and the islands belonging to the present district of Tromsö (Tromsö amt, or Troms *fylke* as the official designation now is). The present boundary between Sweden and Norway, which taken as a whole follows the course of the watershed, was not fixed until 1751. In 1809 Sweden together with Finland ceded the wedge of land to the northwest of the latter country to Russia. But the Lapps with their reindeer could not be confined within these boundaries and be prevented from following their old routes without great risk of starving to death. For humanitarian reasons, in the treaty

of 1751 respecting the boundaries, the Lapps' right of wandering with their reindeer between the two countries and of making use of land belonging to either had been expressly stated.

### The Lapp Question between Norway and Sweden

With the increase of cultivation in the district of Tromsö, where reindeer were customarily pastured at the time when they could do most damage to agriculture, dissension could not be avoided. In 1843 the first Swedish-Norwegian commission was appointed to settle the "Lapp question." This first attempt failed; but it was followed from time to time by others, eventually concluding with the ordinance of June 6, 1883, which remained in force for fifteen years and which has since been renewed on successive occasions. After additional long and comprehensive negotiations, together with careful investigations along financial, scientific, legal, and historical lines, a new Swedish-Norwegian treaty was made on February 5, 1919, regarding the right of the migratory Lapps to reindeer grazing. It is to remain in force from 1923 to 1952. The treaty confirms the right of the Swedish Lapps, especially of the most northern districts, to move their reindeer to grazing grounds in Norwegian territory in the spring as early as May 1. At the same time, however, the grazing grounds in the district of Tromsö have been restricted—all the islands lying outside the coast have been specially excepted; and the number of reindeer that may be moved to the various grazing grounds during the spring and summer has been minutely defined. Swedish reindeer may also be moved into certain tracts in the district of Nordland (Nordlands amt, or *fylke*) during the summer but not into the districts farther south. Regulations in respect to the guarding of the reindeer, the routes by which they may travel, compensation for damage, and other details are also included in the treaty.

The Swedish-Norwegian Lapp question, in itself difficult of solution, has been further complicated by intervention from another quarter, one where the claims of colonizing interests cannot be advanced. During the course of hundreds of years political division of the Lapp country had been effected between Sweden, Norway, and Russia, terminating in 1826 with partition of the territory on the south side of Varanger Fiord between the two last-mentioned states. Certain points of difference remained, however; and, when Norway could not accept the demands made by Russia,[4] Russia in 1852 closed its boundaries, and those of Finland, to the Norwegian Lapps and their reindeer. This action was fraught with disastrous consequences to the Swedish Lapps also. A large body of Norwegian Lapps traveling with reindeer to the reported number of 20,530 but in reality with far more, moved during the years 1853–1871 to the most northerly part of Swedish Lapland where some of them of old had their

[4] In 1851 Russia demanded that the Russian Lapps on the Norwegian frontier should have the right to fish on the Norwegian coast and have a portion of the coast of Varanger Fiord allotted them for settlement. This was considered indicative of a dangerous tendency towards expansion on the part of Russia.

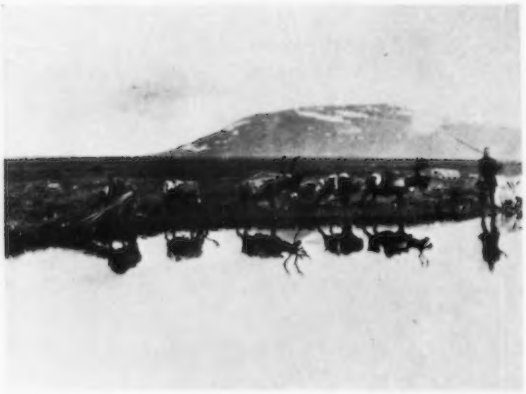

FIG. 3

FIG. 4

FIG. 5

FIGS. 3–5—Lapp migrations. Figures 3 and 4 show migration in summer. The last reindeer carries the tent poles. Figure 5 shows migration in winter.

winter grazing grounds and from whence they could move to their old summer pasturage on the Norwegian coast of the Arctic Ocean, over the wedge of Finland lying between Sweden and Norway. This led to serious congestion, to exhaustion of the grazing grounds, and to other difficulties. When in 1889, this time on the initiative of the Finns, the Finnish boundary was closed to the reindeer of the Swedish Lapps their misfortune was complete.

The Treaty of 1919 just mentioned has necessitated the removal of a large number of Lapps from Karesuando, the most northern parish of Sweden, to districts further south where they will no longer need to migrate with their reindeer to Norway during the summer. This is, in reality, an expatriation, because the Lapps that already inhabited these districts speak a language which is almost unintelligible to the northerners and differ from them in other important respects; and, moreover, the peasant population, with whom they must come into contact during the winter, speak Swedish and not Finnish as in their former homeland. The transition period will thus be troublesome both for the newcomers and for their neighbors.

## The "Lapp Question" in Sweden

Besides these international questions there is that of the internal Swedish Lapp question. The age-old and world-wide quarrel between pastoral nomad and settled agriculturist has been waged here, even in a region of such scattered and insignificant agricultural population as the northern and western parts of Swedish Lapland. The first real law respecting the right of the Swedish Lapps to grazing grounds in Sweden was passed, after lengthy investigations, on June 4, 1886; although long before that, as was natural, several regulations touching these circumstances were in operation. At present a law passed on July 1, 1898, is in force, but further investigations have been going on for a considerable time respecting its revision. This endeavor to reconcile the opposed interests of a specialized primitive culture and those of modern agricultural and industrial development is a matter of concern to the whole nation. In its details the "Lapp question" involves many delicate problems. One of the most difficult, for instance, is that touching the Lapp proletariat, those Lapps who, from one reason or another, have become impoverished and can no longer support themselves as nomads.

An independent farmer cannot exist without a good-sized capital, invested in land, buildings, cattle, and implements; nor can an independent nomad manage without a good-sized capital invested in a reindeer herd and some implements. The farm-laborer question is a hard problem everywhere, and even with the Lapp the servant question has always been a difficult one and in our days is more difficult than ever. In this field also the ideal seems to be "small holdings," i. e. the possession of a herd not greater than the family themselves can manage without outside help. Large herds, depending for the most part or even entirely upon the employment of servant herdsmen, have become more and more difficult to manage, although they still exist to quite a large extent in some districts. Grazing difficulties, disease, and beasts of prey can in a short time decimate and even annihilate a reindeer herd; although, on the other hand, under favorable conditions the herd increases very rapidly. On account of the fairly great risk, therefore, reindeer breeding on borrowed capital only exists to a small extent. In fact this is only a matter to be undertaken by the state, which in this way assists young, diligent, and promising nomads. Heretofore peasants often used to own large reindeer herds, which were managed by hired Lapp herdsmen; but this practice has been forbidden, partly because the Lapps thus came into dangerous dependence on their masters and partly because Swedes and Finns have no right to the historical privileges of the Lapps, in respect of use of the land for reindeer pasturage. Outside the boundaries of Lapland, in the valleys of the Torne and Kalix Rivers, this form of reindeer management is still carried on to a greater or lesser extent.

According to the above-mentioned laws and regulations the Lapps possess the right, during the summer and winter, of using all the mountain and forest lands west of the so-called cultivation line, which during the

years 1868–1890 was drawn northeast to southwest across Lapland and west of which no new settlements were to be made. In the tracts east of the cultivation line but within Lapland itself the Lapps may use the lands belonging to the state or those to which they claim a prescriptive right, although the lands may have been granted to private settlers also. Equally during the period from October to April they may sojourn with their reindeer in districts east of the boundary of Lapland and east of the reindeer-pasture mountains in the provinces of Jämtland and Härjedalen which they visit according to ancient custom. Thus their privileges are in reality very extensive.

Relations between the Lapps and the settled population are supervised by four Lapp bailiffs, assisted by several overseers. In other respects the Lapps are under the same administration and jurisdiction as the settled population and have the same duties and rights. During peace times they are, however, exempt from military service, and, as a rule, their taxes are trifling—a circumstance which has not perhaps proved entirely to their advantage.

## Number and Distribution of the Swedish Lapps

In the year 1910 Swedish Lapland with an area of 117,984 square kilometers (45,550 square miles), a little larger than Pennsylvania, had a population of 81,535 persons (in 1919, 93,888), of whom only 5738 were Lapps, 6635 Finns (in the most northerly part), and 69,162 Swedes. Of the Lapps 2196 were nomads. Besides this in the same year (1910) in the provinces of Jämtland (37,513 square kilometers, or 14,480 square miles) and Härjedalen (12,849 square kilometers, or 4960 square miles) with a total of 118,115 inhabitants (in 1919, 128,066) altogether, and including a few families in the province of Dalecarlia, there were 904 Lapps, of whom 725 were nomads. In the whole of Sweden in 1910 there was a total of 7138 Lapps. The number of Lapps in the country seems to be fairly stationary. The natural increase appears to be counterbalanced by the number who become nationalized Swedes or Finns or remove to Norway.

Respecting the distribution of the population in the different parts of Lapland, some idea may be formed from the fact that in 1910 in the parishes of this province which lie south of 66° only the easterly ones, which are largely or entirely forested, had a population of from 1.0 to 2.3 persons to the square kilometer (one of them had only 0.8); while the western parishes, where the mountains take up the greater part of the area, and also the parishes lying north of 66° had considerably less than 1.0 person to the square kilometer. The parish of Karesuando, farthest north, had only 0.2 person per square kilometer. Of its 1198 inhabitants, 717 were Lapps, 442 Finns, and 39 Swedes—the last consisting only of officials and their families. It is the only Swedish parish in which the Lapps at the present time are in the majority. The parish of Jokkmokk, the largest, lying just north of 66° and having an area of 19,474 square kilometers (7520

square miles, a little less than New Jersey) had 5416 inhabitants in 1910, of whom 520 were Lapps and 69 Finns. In the two parishes Gellivare and Jukkasjärvi, lying between Jokkmokk and Karesuando, are situated the two large mining communities, Gellivare-Malmberget with 3872 and Kiruna with 5964 inhabitants in 1910 (in 1920, 6542 and 7392 respectively)—a new factor which entirely changes the character of the population statistics. Thus in 1910 the Lapps formed only a very small proportion of the population in the whole of the province of Lapland—7.0 per cent against 84.8 per cent Swedes and 8.2 per cent Finns; in Jämtland and Härjedalen their numbers were exceedingly small—only 0.77 per cent of the whole population; and it is evident that the percentage of the Lapp population will continue to decrease in all these provinces in the future.

## The Lapp Dwellings

Where the migrations of the nomadic Lapps range over extensive districts and where they cannot hope always to settle themselves in the same localities, naturally they are unable to use any fixed dwellings but must live in tents both summer and winter. The Lapp tent, which in all districts is essentially the same, consists of a light, removable, and portable frame formed by a number of wooden poles specially made for this purpose upon which is stretched a tent cloth of thick sacking or, in the farthest north, a kind of woven blanket. Nowadays the tent cover is never of reindeer hide or leather. Both the sacking and the woven blankets must be bought, as the Lapps neither have nor could have larger looms than hand ones on which ribbons are woven. The tent is conical with an outlet for smoke at the top about one and a half meters wide; its height is about two meters; its diameter at the base is about four or five meters. On the ground in the middle of the tent is the fire, and over this hangs the kettle. On both sides of the fire the ground is strewn with small twigs, covered by reindeer skins on which the people sit by day and sleep at night. At the back of the fire, as seen from the door, are kept the cooking utensils; the fuel lies between the fire and the door, that is the triangle-shaped opening between two tent poles which is closed by a curtain stretched on cross poles. No table, chairs, or beds are to be seen; only a pair of small chests or some equivalent receptacle. The bedclothes, that is thick rugs of sheepskin or reindeer calfskin (not sleeping sacks) meant for two people, lie during the daytime pushed away under the edges of the tent.

When the weather is clear the tent is pleasant, airy, and light and, when the fire is burning, it is a surprisingly warm dwelling; but when it rains or is foggy the smoke usually stays inside and becomes extremely troublesome. The smoke, the falling reindeer hair, and the white ashes that are blown about in windy weather make it difficult to keep the tent clean at all times. During the night the fire is allowed to die out to prevent sparks flying on to the bedclothes, and one is therefore obliged to sleep fully dressed, espe-

cially during the winter. Beside the tent stand the temporary sheds for the preservation of meat, provisions, etc. The Lapp usually has also a solidly built storehouse in some peasant village, where he keeps all kinds of property. Even among the mountains one sees now and then small buildings for the same purpose, placed at the top of single, high, strong post or on a cliff only accessible by a ladder—all this as a means of protection against beasts of prey, particularly wolverines.

In districts where the migrations are not so extensive, and especially in the south, but also in the mountains of South Lapland and by the great lake Tornetrask, one meets with permanent huts instead of the tents; they are of the same construction and of about the same size as the tents but are made of thick stocks and roofed with birch bark covered by turf. They are less airy than the tents but naturally warmer; in unfavorable conditions they can be unhealthy. At the same time in many districts the nomads have begun to take lodgings with the peasants during the winter. This is unfortunate, for they are apt to fall into dependence upon the peasants; and furthermore the reindeer nomad is unaccustomed to the standard of hygiene required in a permanent dwelling.

Nowadays the Forest Lapps usually live in wooden houses of the common north-Swedish type; but they often have also on their lands one or two huts either of the type described above or made entirely of boards with a pyramid-shaped upper part set upon a square base.

## Means of Transportation

The reindeer sledge is the most interesting of all the special implements of the Lapps. It has only one runner and looks like a little boat with an abruptly truncated stern. It is drawn by only one animal. There are no shafts but a strong leather trace that passes between the reindeer's legs and ends in a loop or ring of skin round the neck. Latterly in the most northern tracts, a kind of harness, something like that used for horses, has come into use; but even this is connected with the sledge by a single trace and not by shafts. The sledge is usually open but sometimes is closed, when it resembles a coffin and is used as a repository for the more delicate and precious articles. In olden times the Lapp sledge was evidently hand-drawn, developed probably from a hollow log. In some districts two other kinds of sledges are also in use, having two runners, which seem to have developed from the dog sledge formerly used in northeastern Europe.

For purposes of transport in the summer the usual kind of saddle is not used; but two flat, semicircular boards are coupled into each other over the fore part of the reindeer's back and firmly bound together under its belly. The reindeer is not used for riding, excepting occasionally by children. It very seldom becomes so tame that it can be caught by hand, but as a rule a lasso must be used. A halter is afterwards put over its head, connected with a single strong leather rein.

FIG. 6

FIG. 7

FIGS. 6-7—The Lapp tent. In Figure 6 part of the cloth is thrown back to show the construction.

Snowshoes are unknown. Instead of them skis are used with utmost dexterity. The skis seem to have been invented in and to have spread from two different centers. In the east, that is in Siberia and North Russia, they were and are covered on the underside with skin, having the hair pointing backwards, both skis being of the same length; the ski runner advances by gliding forward on one at a time, using both alternately. In the west, among the Scandinavians, the left ski was much longer than the right and was not covered with skin; the right ski, however, was covered underneath with skin, and the ski runner advanced by gliding forward on the left one and kicking with the right. With the Lapps and Finns these two types have subsequently been combined into the present form, the long bare skis of equal length which are familiar to us in sport.

## Dress

Among the Lapps the clothes of both sexes are almost alike and consist of a cap; an inner tunic or, in winter, a fur coat of reindeer skin with the hair inside; an outer tunic or fur coat with the hair outwards, longer for the women than the men; tight trousers; and shoes similar to moccasins, turned up at the toes and stuffed with hay and joined to the trousers by a tightly drawn bandage twisted several times round the small of the leg. All the furs are sewn together by specially strong thread of reindeer sinews. Tunic and fur coat are confined round the waist by a woven band or, in the farthest north, by a broad leather belt from which hang two knives, giving a rather warlike air to the wearer. The breast is covered by a special, beautifully ornamented garment, hanging from the neck. The high collar of the tunic (found only on the men's garments) and neck opening are generally ornamented with colored cloth. The farther north one goes, the more variegated becomes the dress, banded with broad yellow and red stripes. The material of the tunic is usually dark, black or gray frieze or blue cloth. During the summer leather clothes are also used or worn fur coats.

The cap is different for the two sexes and for old people and children; it varies also according to district, and by it one can tell at a glance where a Lapp comes from originally. In shape it is conical, blue for the men and red or reddish for the women; in certain tracts the men's cap is decorated with a long red tassel, but never the women's; the men's cap in certain districts has a peak. Among the Lapps who have recently immigrated from Norway a man's cap highly variegated and with a square "Polish" crown has appeared in the farthest north. The woman's cap that appeared at the same time has also a peculiar shape, fitting the head closely and trimmed round the cheeks and forehead with broad, projecting lace. The dress of the Lapps taken as a whole is practical and gives a pleasing and picturesque impression. In most districts it is carefully preserved, but in some places the man's cap threatens to disappear and make way for a hat of the usual type. Furthermore, waistcoats and shirts are coming into general use.

The beautiful ornamentation of the dress shows a natural good taste, which is further exhibited in the tools, expecially in the knife shafts, knife sheaths, spoons, buckles, needle cases, pipe cases, knobs for staffs, etc., which are made from horn and adorned by carvings; among these may even be found certain antique Scandinavian patterns. None the less the articles made for selling to tourists are very often rude and ugly.

## Food

The food of the Lapps, where it is still of the more primitive kind, consists for the most part of products of the reindeer, that is meat and blood (used

Fig. 8—Lapps round the camp fire; the men have the lasso over the shoulder.

in gruel, pancakes, and sausages) together with milk (fresh, frozen, or in the form of cheese but not butter). Reindeer marrow is considered a delicacy, and marrowbones are sent in the course of trade all over northern Sweden. Flour is bought, and nowadays ordinary fermented bread where formerly only home-baked bread, unfermented and made from barley-flour, was used. Potatoes are eaten when they can be obtained, but as a rule the peasants live too far away in the summer and there are no facilities for keeping potatoes during the winter. Special Lapp vegetables are *Angelica archangelica*, *Mulgedium alpinum*, *Rumex acetosa*, and *Oxyria digyna*. Coffee is drunk in large quantities, in the north altogether too much; even tea is used sometimes. Spirituous liquors are rarely met with; no kind of

fermented or distilled drinks of their own is known to the Lapps who as regards temperance are now irreproachable as a rule.

## Swedish Influence on the Primitive Religion of the Lapps

Some attempt to Christianize the Lapps was made during the Middle Ages; but the first serious effort was not begun until the sixteenth century, when some small churches appear to have been built in their country. Among them was the once renowned but now vanished church at Rounala, up in the mountains on the present boundary between Sweden and Finland, which according to tradition was built by three Lapp brothers at their own expense. During the first years of the seventeenth century more churches were built in the principal localities of Swedish Lapland, which at the same time were organized into the administrative divisions that as a whole have been retained to the present day. The first two Lapp books were printed in 1619, a primer and a little book of religious services; and in 1631 the first school in Lapland was founded at Lycksele. This school, which is still in existence although now an elementary school and removed higher up in the mountains, was intended for the education of Lapp boys as priests to their own people. The work of the seventeenth century was continued with still greater zeal during the following century under the direction of a special "Ecclesiastical Board for Lapland," appointed in 1739.

There is good reason for saying that Lapp paganism, which according to available sources appears to have been a mixture of indigenous Arctic-Shamanistic, ancient Scandinavian, and Christian elements died out completely in Sweden towards the end of the eighteenth century. Only here and there, as in all other nations, is one reminded of it by certain superstitions. Strangely enough such reminiscences appear mostly in the northern part of Lapland where the population, both the Lapps and the Finn settlers, ever since the fourth decade of the nineteenth century have been deeply influenced by the powerful, gloomy, ecstatic religious movement which has been named after its author, the Reverend Lars Levi Laestadius (1800–1861). It has spread over the whole of the territory in Finland, Sweden, and Norway where the Finnish language is spoken and has even been carried to America by Finnish emigrants.

The pagan religion of the Lapps found its most peculiar expression and instrument in the magic drums, i. e. Shaman drums of tambourine shape of the same kind found even today among the primitive tribes in Siberia and northeastern Russia. These drums, which had a skin drawn over one side only and were hung with all kinds of jingling ornaments, were held by means of a handle at the back and were beaten with a single drumstick like a hammer. A number of figures representing gods and spirits, heavenly bodies, houses, beasts of prey, reindeer, etc., were painted on the outside of the parchment; and future occurrences were foretold by the help of a bunch of brass rings, which were laid on the drum skin and at the strokes of

the hammer jumped about on the figures. This use of the drum is, however, a secondary one. Originally it was used as an instrument of excitement through the booming of which the Shaman gradually reached a state of ecstasy and at last fell into a trance, during which his soul was believed to fly to distant places or down to the kingdom of death, where it fought the ghosts of the dead for the souls of sick persons. The Lapp drums have disappeared long ago and are now among the greatest rarities of the ethnographical museums. They held their place longest in the most southerly districts, where they were used for fortune telling at a time when in the north even the memory of them had vanished.

## The Problem of Lapp Education

As a result of the nomad life led by the Lapps the problem of their education is very difficult of solution, and it has been the object of various experiments during the course of time. Today children first receive instruction from women teachers, often of Lapp birth, who move about with the Lapps and live in their tents. Then follows a somewhat higher education in boarding schools. Great importance is attached to keeping the children's interest in their fathers' mode of life, and books specially prepared for this purpose are coming into use. Swedish is now used everywhere in the schools. Formerly it was Swedish in the south, Lappic in the middle regions, and Finnish farthest north; but the Lapp's knowledge of Swedish is now becoming so general that it can be used for instruction in the schools. The many different Lapp dialects made education in this language difficult, as no form of the native language is common to a large enough group even in the Swedish Lapp districts to be reduced to writing. Furthermore, the use of the Lapp language in religious services is passing out; at present it is only used in a couple of parishes in the central districts; it is replaced by Swedish or, in the farthest north, by Finnish. In the past many priests have come from the Lapps themselves, but at present only one is a university man. The Lapp language, however, shows no signs of disappearing but is preserved carefully in the homes, especially while the Lapps are nomads and very often long afterward. For many years all adult Lapps have been able to read and write.

## The Future of Reindeer Breeding and the Nomadic Lapp

It is common experience in Sweden that the children of nomadic Lapps who possess an inherited reindeer herd generally remain nomads. The toilsome and fatiguing nomadic life has its pleasures and advantages too, and those who from childhood have been used to its freedom do not willingly give this up unless the external difficulties become too great. Added to this, during normal years and on the average, reindeer breeding pays exceedingly well. Reindeer meat is easily sold and much liked all over the country; reindeer hides can always be sold, no matter how great the quantity pro-

duced; and, lastly, the Lapps are usually good business men who can take care of their own interests. Nomadic life, on the other hand, is checked by advancing agricultural and industrial interests as we have already shown.

The most serious impediment to reindeer breeding and to the continued existence of the Lapps as a distinct national group is to some extent of an internal nature. In southern Lapland the nomadic Lapps, to a very large extent, have procured larger or smaller farms in the mountain districts, where part of the family live all the year round while another part, generally the man and his employees, wander with the reindeer during the winter to a distance of from 200 to 300 kilometers away from home or even farther. During the summer the farm too must be cared for, and this necessarily draws away interest from the reindeer herd and its proper management. It is also doubtful whether the children who have grown up in the cottages of these farms will be willing in the long run to undertake the burden of nomadic life. The matter is, however, of such great importance for the whole of northern Sweden that the state cannot willingly allow reindeer breeding to fail. In the north especially, and even in the south in many quarters, the interest in reindeer breeding which seemed to have declined appears to be reviving again, and it is not impossible that the social movement which began among the Lapps some years ago may also work in the same direction. As an organ for this movement a little journal is edited (in Swedish and Finnish) by a Lapp who has studied law at the University of Upsala.

This matter, however, like all others, will depend in the end upon the personal strength and desire of the people themselves. It cannot be denied that the mercurial Lapps not seldom show some lack of firmness and determination; but, on the other hand, they have succeeded in a characteristic and unique way in maintaining in the heart of a highly civilized community their own peculiarities and their nomadic life. It is to be hoped, then, that the Lapp element will endure. The state could ill spare them, either as producers of meat and hides or as exploiters of enormous districts which are absolutely useless for other purposes. In reality no small sum of money is vested in reindeer breeding in Sweden. In 1911 the number of reindeer in that country was over 275,000, and in 1921 it was about 168,000.[5] According to the above-mentioned Swedish-Norwegian treaty, for the years 1923–1952, 39,000 Swedish reindeer are allowed to graze during the summer in the district of Tromsö and 29,850 in the district of Nordland in conjunction with immigration rights for the Lapps; a number of reindeer—how many is not exactly stated—are likewise allowed to graze during July and August in certain tracts near the frontier inside the last-mentioned district, although the Lapps themselves are not allowed to move in but only to send the necessary herdsmen.

The size of the herds varies of course considerably. Herds consisting of

[5] The number of reindeer fluctuates very much from year to year, and one need not regard the reduction of numbers during the ten years mentioned as anything but an accidental occurrence.

more than 1000 animals are exceptional, but herds of this size are found at present in some districts in fairly large numbers. Such large herds, however, can be managed only with outside help. The largest number of reindeer that can be managed by a moderate-sized family, without the help of strangers, seems to be from 400 to 500, which represents no inconsiderable amount of capital. Several families often combine and manage their herds together—a plan which, given suitable geographical conditions, is of advantage. The herds at certain times of the year must be watched continually both day and night; and this demands great endurance and activity, as the reindeer is an easily-frightened and swift-footed animal. All the adults and all the youth of both sexes must as far as possible take part in this watch, assisted by the well-trained intelligent dogs.

When insufficiently guarded the herd easily disperses, and a reindeer herd run wild soon causes disorder among the neighboring herds also. The reindeer never come inside dwellings; during the summer they are driven into large enclosures for milking or for the separation of strange deer; they are taken home now and then during the winter for examination and the separation of animals for slaughtering purposes; and the herd are then encamped for some hours on a level spot near the dwelling place.

The milking of the reindeer is a troublesome and time-consuming process. It exacts careful management of the herd and unfortunately is beginning to drop out of use. The reindeer cows produce very little, but extremely rich, milk from about midsummer till towards Christmas; the calves are born about the middle of May and during the first months require all the milk the cows can give.

As a beast of burden and for driving purposes the reindeer with its small size and relative weakness cannot be compared with the horse. On the unbeaten tracks among the mountains, however, where the horse can only proceed with difficulty, the reindeer, because of its broad hoofs and light weight, does not easily sink into the snow and is thus a very useful and adaptable animal. The reindeer still plays no small part, therefore, as a means of communication in certain districts; and one can sometimes see, as in Kiruna, such an anachronism as long strings of reindeer with their sledges marching along by the side of an ultramodern electric tramway. The reindeer is an excellent swimmer and can cross fairly broad straits to the isles outside the coast. The wild reindeer has long since completely disappeared from Sweden.

Those who have not themselves seen the life of the Lapps and who do not know the conditions in their country often think it would be doing them a service to persuade them to give up their nomadic life and thereby "improve their culture." These persons overlook the fact that culture takes many forms and that the point which a civilization has reached depends in great measure upon geographical conditions over which mankind has little control. A peasant or mechanic does not necessarily stand higher as regards culture than a sailor, although the last follows a "nomadic" life of a consid-

erably more intensive kind than does a reindeer-breeding Lapp. A nomadic Lapp need not theoretically stand lower as regards culture than does a peasant living *in the same tract.* In fact one often sees the opposite: the nomad goes out into the world and sees more than the peasant does; he gains greater experience, more knowledge, better manners than does the settler bound to the soil in the mountain districts. Generally speaking, however, we can say that the Lapp's position in regard to culture is much the same as that of the peasants with whom he most often and most closely comes into contact, that he is as well-informed as they are, about as tidy or untidy as they are, and holds about the same views of life as they do. That the finest flowers of culture cannot open or thrive in a Lapp tent is obvious; but it is just as impossible in the neighboring farmhouse. But no one for the sake of culture attempts to decoy the inhabitants of these farmhouses away from the wastes they live in to an uncertain fate in the big towns.

It should not take even the chance visitor to their territory long to discover that the Lapps are by no means "savages" and that it would be both unmerciful and foolish to lure them away from a mode of life whose value both to themselves and to the community at large casual observation gives no means of estimating.

# THE PORT OF STRASBOURG

By J. Levainville

The fortunes of Strasbourg arose from its position at a crossroads which by land and water put the town in touch with countries of rich and varied resources.[1] On the immediate outskirts of the city is the Rhine affording a means of communication between the Alps and the lowlands bordering the North Sea; the Kinzig drains the plain of Baden and the Black Forest and leads to the Danube; the Ill, traversing Alsace, opens ways into Switzerland and, by the gap of Belfort, into Franche-Comté and Provence and to the Mediterranean coasts. Finally, in the west is the old Roman road crossing the Vosges by the Col de Saverne to pass thence through Lorraine and Champagne to the Ile de France. In good time on the banks of the water-courses or along the borders of the roads which passed through this nodal point, quays and warehouses were built and the port came into being. The monopoly of transportation was in the hands of the powerful guild of boatmen, who were known to their contemporaries as "promoteurs et inventeurs" of navigation on the upper Rhine. Together with wholesale merchants and boat builders of the town they formed the famous corporation of the Ancre which met at the tavern "zum Ancker" and there held a sort of freight exchange whose function may be compared to the present-day meetings of Lloyds. The majority of its adherents lived in the southeastern quarter of the town, in the Krutenau, and they had a preponderant voice in the city council.

The prosperity of the port suffered frequent interruption through the wars that time and again devastated the regions tributary to the port—the revolt of the Netherlands, the Thirty-Years war, the Dutch war, the campaigns of the Revolution and the Empire. But later more serious effects were sustained from economic causes, such as the competition of Kehl. In particular the beginning of the railway era marked a period of decline. Merchandise from Basel to London was sent by rail instead of by the more expensive Rhine route. Decline was for a time arrested by the opening of canals giving access to the port—that of the Rhone-Rhine in 1841, the Marne-Rhine in 1853. This measure had for its result a change in the function of the port. Traffic on the river, almost completely abandoned by the big barges, was restricted to lumber rafts and fishing boats, and to vessels carrying sand and gravel. On the other hand, anchored at the quays of the port might be seen numerous pinnaces loaded with coal from the Saar and

[1] See especially Lucien Gallois: Le port de Strasbourg, *Ann. de Géogr.*, Vol. 28, 1919, pp. 414–424; Gaston Haelling: Le Rhin politique, économique, commercial, Paris, 1921; G. Arnaud: Le port de Strasbourg, Paris, 1921. M. Baulig, professor of geography at the University of Strasbourg, has photographed especially for this article certain aspects of the port, for which grateful acknowledgment is here made.

Belgium, grain from Alsace, the north of France, and Flanders, building materials from the Vosges, wines from Alsace and France.

The war of 1870 and the Treaty of Frankfurt closed to the port its western outlets. In 1889 traffic was barely 162,000 tons, a miserable figure compared with that of other Rhine ports; Duisburg-Ruhrort, 5,312,000 tons; Mannheim-Ludwigshafen, 3,299,000 tons. The attention of the Alsatian port was specifically directed towards the Rhine; but here traffic was susceptible of development only if the river were regulated to permit the access of large barges at all seasons of the year. As it was, the larger craft could only reach the port during the seasons of high water, some 150 to 200 days a year; most often they were compelled to lighten their cargo or to stop altogether at Mannheim.

It was the great port of Baden that offered the most strenuous opposition to the improvements projected by Strasbourg. Mannheim was unwilling to lose its dominant control of transit trade on the Rhine for goods from Belgium, Holland, and Westphalia destined for Bavaria and Switzerland. It took 30 years of persistent effort to overcome this bitter opposition. In fact, though the arrival at Strasbourg of the Rhenish steamer *Industrie 24* on June 16, 1892, may be said to have marked the resumption of navigation on the upper Rhine, development of a really intensive traffic only dates from 1913 with completion of the work (in hand since 1907) providing a minimum depth of 1.90 meters in the fairway. The port itself has been transformed by parallel improvements until it compares favorably with its powerful rivals on the Rhine. It is a thoroughly up-to-date economic organism that has been returned to France by the Treaty of Versailles.

## Access to the Port

### The Rhine

In spite of numerous tributaries descending from the Vosges and the Black Forest, the Rhine from Basle to Strasbourg is characterized by a torrential regimen betraying its Alpine origin. Seasonal variations—summer floods and winter low water—are the more pronounced and rapid as the gradient is steep from Basle to Strasbourg. It is 1 in 1000 to Brisach; 0.6 at Kehl and as far as Rastatt, whence it decreases to 0.19 at Mannheim. A barge which carries a full cargo to Strasbourg in summer must discharge half en route in winter. Rhine navigators invariably allow a margin of 30 centimeters between boat keel and river bed to guard against sudden fall in the waters which may be very rapid in case of drought.

Depths of the channel in different sections of the river are these: from Strasbourg to Mannheim, in summer 2.8 meters, in winter 1.7 to 2.1 meters; from Mannheim to Bingen, in summer 2.8 meters and more, in winter 2.3 meters; Binger Loch, from 2 to 2.9 meters; from St. Goar to Cologne, 2.9 meters except during three months of summer when it varies from this figure to 2.49 meters; from Cologne to the sea, between 3 and 3.9 meters

at all seasons. The river may thus be divided into three different stages through which passes merchandise loaded at Rotterdam or Antwerp for Strasbourg: to Cologne on the maritime Rhine; from Cologne to Mannheim on the lower Rhine; from Mannheim to Strasbourg on the upper Rhine.

FIG. 1—Sketch map showing the means of access by water to the port of Strasbourg. Scale approximately 1:5,250,000.

In each of these sections merchandise makes use of different equipment and facilities for transportation. The port of Strasbourg by reason of its situation and the geographical conditions of the Rhine is in strict dependence on Antwerp and Rotterdam, its points of contact with the sea; on Cologne and Duisburg, transshipping points for the large barges and highpowered tugs; and on Rheinau and Mannheim where are warehouses to receive the un-

loaded surplus and basins where are made up the trains of barges or freight cars for the last stage of the journey.

## The Canals

Strasbourg, which at the beginning of its history under the Roman conquest was a town of land routes, became during the French period a town of canal routes. Twice it was the canals constructed by French engineers that saved from decay the port abandoned by Rhine navigation.

The first canal, that of Bruche, 20 kilometers long, was cut in 1682 after the plans of Vauban and was designed to transport stone and other material from Molsheim for building purposes and fortifications. Completion of the Rhone-Rhine canal, begun under Louis XV, was retarded through political events; and the canal was only opened to navigation under Louis Philippe. It commences at St. Symphorien on the Saône, follows the Doubs, crosses the watershed at Valdieu, and traverses Alsace between the Ill and the Rhine. At Mulhouse the Hüningen canal branches off to the Swiss frontier. The Marne-Rhine canal, begun in 1827, was opened to navigation between Nancy and Strasbourg in 1853. It crosses the Vosges by a tunnel at Artzwiller. Two branches serve Lorraine, the Saar canal (canal des houillères) and the canalized Moselle.

The network of waterways centering about Strasbourg would have formed a homogeneous whole had its unity not been broken by the Treaty of Frankfurt. The Freycinet laws (1879) called for a depth of two meters on the French canals, the depth required by the Flemish pinnaces of 280 tons. But this transformation did not affect the Alsatian sections, whence a troublesome transshipment was imposed on freight. A German law of 1892 called for the same depth on the canals of that country. The measure was carried into effect on the Saar and the Marne-Rhine canals but not on the others. The Rhone-Rhine canal terminated in a cul-de-sac at Mulhouse, that of Hüningen at Kembs; the Moselle was only canalized as far as Metz. Strasbourg found itself deprived of relations with important industrial and commercial regions: to the northeast the mines and metallurgical works of Lorraine and Luxemburg; to the south the Swiss plains, great importers of coal and grain. To break these barriers against its growth Strasbourg exhibited the same energy that had been displayed in regulating the Rhine. Before the war the Hüningen canal had been increased to a 225-ton capacity; but improvement of the port depended on arrangements with Switzerland. Negotiations to this end, which were interrupted during the war, have since been renewed.

The most tangible result has been obtained in the last few years on the Rhone-Rhine canal. On May 27, 1919, M. Millerand, commissioner general of the French Republic at Strasbourg, ordered the commencement of works on the Alsatian canals to accommodate the 280-ton pinnaces. In spite of the handicaps existing at the time, the enterprise was carried forward with

great rapidity. Today navigation is as easy on the Rhone-Rhine canal to Lyons as it is to Nancy on the Marne-Rhine canal. It is a convincing example of French energy in reconstruction after the war.

### The Railroads

The line from Strasbourg to Basel was opened in 1844, Strasbourg to Paris in 1852, Mulhouse to Belfort in 1858, Strasbourg to Kehl in 1861. These years marked a period of decline for the port, for the Rhine navigation was almost annihilated. Today rail and water traffic are closely co-ordinated to mutual advantage. As shown in Table I, the major part of the importations are carried by water, of exportations by rail.

Table I—Trade of the Port of Strasbourg (1913)

| Routes | Importations | | Exportations | |
|---|---|---|---|---|
| | Tonnage metric tons | Per cent | Tonnage metric tons | Per cent |
| Rhine | 1,655,000 | 70 | 340,000 | 22 |
| Marne-Rhine canal | 190,000 | 8 | 160,000 | 2.5 |
| Rhone-Rhine canal | 78,000 | 3 | 265,000 | 16 |
| Bruche canal | 54,000 | 2 | 1,900 | 0.1 |
| Railroads | 413,000 | 10 | 979,000 | 58 |

The line from Strasbourg to Kehl is the great collector of traffic. On the right bank it serves the Rhine provinces, Prussia, Bavaria, Switzerland. On the left bank it commands the ways to the northwest to the Palatinate, to the north by the Sarrebourg line towards the Saar, Belgium, Luxemburg, and Lorraine; to the west to the Vosges; to the south to Upper Alsace, Switzerland, Burgundy, and Provence. The dual focus of routes Strasbourg-Kehl is a medium of world traffic, a circumstance which explains the rivalry between the two railroad stations, each of which seeks for itself the benefit of the transit trade. Up to 1914 the railways of Baden and Alsace were engaged in a tariff war. The German Empire was long opposed to development of the system on the left bank of the Rhine. But here again Strasbourg exhibited its characteristic qualities of initiative and energy and eventually secured an accord by which it enjoyed equal tariff with Kehl on freight in transit to Switzerland. This tariff, however, was only applicable for the Alsatian station on water-borne goods.

### Traffic of the Port

Paralleling the improvement in ways of access were the port works undertaken by the Strasbourg Chamber of Commerce. It would take too long to recount here the struggles against the military engineers of the German

army and the various discriminations against the new port, but in the end the Strasbourgers gained an economic victory. The port as rendered to France by the Treaty of Versailles includes three series of basins situated to the south of the town between the Ill and the Rhine at the confluence with the Little Rhine, the last constructed in contact with the river. The total area of the basins is 44.86 hectares, of the port 200 hectares; and there are 10,710 meters of water front.

The business of the port is almost entirely a transit trade in bulk goods. Of the total of goods entering the port (upstream and downstream) 88 per cent was accounted for by the following items: fuel (934,000 tons), grain (516,000 tons), petroleum (24,000 tons). Of goods leaving the port 76 per cent was accounted for by iron goods and machinery (102,000 tons), potash salts (71,000 tons), lumber (42,000 tons), and salt (35,000 tons). Before the war coal formed the principal commodity handled by the port. Strasbourg is splendidly situated as a coal *entrepôt*. Coming by way of the Rhine, coal from England, the Ruhr, and the Aix-la-Chapelle region is discharged on the quays beside coal from Belgium and the Saar which furnishes an important freight on the Marne-Rhine canal and the railroads. The chief customers for Strasbourg coal were Switzerland (323,000 tons), Upper Alsace (244,000 tons), eastern France (123,000 tons), Baden and southern Germany (30,000 tons), and southern France (10,000 tons).

The harbor installations of the Westphalian and Rhenish coal companies, covering 40 hectares, are the finest in the port. The total facilities of the port permit of a coal transshipment of about 500 tons per hour; the dockyards can carry a stock of 500,000 tons. The briquette factory of Hugo Stinnes on the Austerlitz harbor could deliver 65 tons a day.

Since the armistice the German concerns have been transferred from Strasbourg to Kehl. Their installations have been sequestrated, and French business men of the commercial hinterland of Strasbourg, Nancy, and Grenoble have been in charge of the commercial function of the port.

The grain trade also contributes a characteristic feature to the port. The six-storied warehouses, electric cranes, and elevators dominate the quays. In sum the warehouses afford 64,150 square meters of utilizable surface and can stock 13,600 tons. This equipment is divided between the two great milling establishments on the Commerce basin: the Société des Moulins Illkirch and the Société des Moulins d'Alsace. They have a grinding capacity of 5500 sacks and 1600 sacks per day respectively, and their grain silos storage capacities are of 150,000 tons and 30,000 tons.

Before the war, grain came chiefly by way of the Rhine from Russia and America (502,000 tons in 1913). It was distributed to Switzerland, Alsace, Lorraine, and in small amounts to the neighboring frontier regions of France. In this respect the rôle of the port of Strasbourg was almost entirely regional.

Of the other products entering into the port trade and representing 36 per cent of the total tonnage, petroleum, potash, and iron ore may be given separate mention.

The petroleum industry has assumed a great importance with the conclusion of peace. The Alsatian mines of Pechelbronn have replaced a German concern. Three French companies have constructed tanks and opened storage depots, awaiting the completion of the new petroleum dock which is one of the projects of port extension.

It appears also that Strasbourg will become the great port for the shipment of the Mulhouse potash. Extraction, limited to 350,000 tons in 1913, exceeded 600,000 tons in 1919 and will attain 2,300,000 tons in 1922. Of this total 1,000,000 tons will be sent by the Rhine to Belgium and oversea countries.

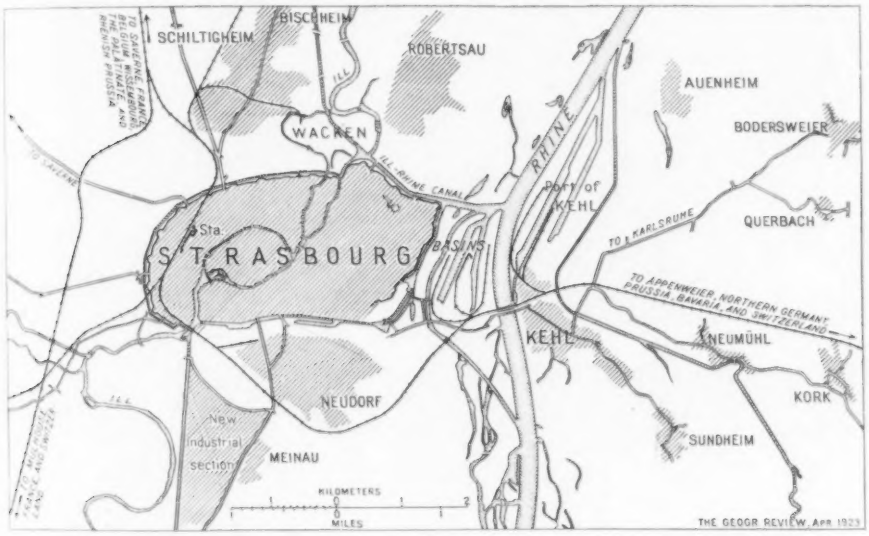


FIG. 2—Sketch map showing the immediate vicinity of the port of Strasbourg. Scale approximately 1:115,000.

The future also appears good for transit trade in iron ore. In 1914 some use was made of the waterways to send ore from Lorraine to Westphalia, and during the war congestion on the railroads obliged almost complete dependence on the Rhine. The continuance of this traffic appears to be bound up with the importation of coke for metallurgical purposes. The friability of coke makes it ill adapted for frequent transshipment. To obviate this inconvenience several big German firms situated in the industrial section of the port had bought the necessary equipment for the construction of coke ovens. Thus coke manufactured here can be carried by rail from Strasbourg to Lorraine, and ore can be sent as a return freight whence it will go down the Rhine to Ruhrort.

### The Future of the Port

Petroleum, potash, and iron ore are local products within the sphere of Strasbourg's commerce. But it would seem that the port may legitimately

FIG. 3

FIG. 4

FIG. 5

FIG. 6

FIGS. 3–6—The port of Strasbourg. 3, Basin of Commerce, looking towards the mouth: on the left, municipal warehouses; to the right, grain elevators; and in the distance, cranes for discharging coal. 4, Basin of Industry, looking towards the mouth: to the right, iron works of Strasbourg; to the left, wood yards. 5, the Junction Canal, manufactory of pressed fuel. 6, Austerlitz docks: Rhine boats discharging coal from the Ruhr.

claim to serve other French provinces than Alsace and Lorraine. Released from the handicaps of German control, the port furthermore acquires a greatly enlarged economic hinterland. Henceforth fifteen French *départements* at the greatest distance from the coast will possess an outlet to the sea. One can say with truth that Strasbourg is the maritime port of eastern France.

According to the port management of Strasbourg and Kehl the annual requirements of this new economic hinterland are: coal, 2,000,000 tons; grain, 300,000; oil seeds, 110,000; phosphates, 50,000; wood pulp, 100,000; other articles—colonial products, cotton, wines, etc.—700,000. If to this is added the 1,500,000 tons which Strasbourg already distributed to Alsace and Switzerland before the war and a prospective increase for the mining industries, the trade of the port in the near future may without undue optimism be estimated at 7,000,000 tons. Trade in 1920 (1,820,000 tons) closely approached that of 1913. In fact without temerity a future trade of 10,000,000 tons may be forecast, though to realize this dream extensive improvements will have to be carried out in the port itself.

## A French Fleet on the Rhine

The first difficulty has already been solved. Before the war the trade on the Rhine was practically entirely in the hands of Westphalian industrials and of the German state. The non-German flag was represented on only 13 per cent of the tonnage reaching Mannheim and 8 per cent of that reaching Strasbourg. On the signing of the armistice many French companies were formed for navigation on the river. They ran up against a stumbling block in the attitude of the German towing companies. The actual transportation remained as before the war in the hands of the Germans, some Dutch companies being excepted. Freight charges began to show the effect. As at the beginning of the railroad era, water-borne merchandise discharged at Rotterdam paid a higher rate than that carried by rail. Since traffic on the Rhine calls for specialized forms of transport and dock facilities, the cheapening of river transport could be brought about only if France were given a balanced award of facilities of every kind. Provision for this was made in the Treaty of Versailles (Articles 339 and 357), and it has been carried out according to the decision of the American arbitrator, Mr. Walker D. Hines. He allocated France 13½ per cent of the German Rhine fleet—254,150 tons of barges and tugs of a total of 23,760 horse power—to be ceded immediately; a supplementary cession to be made if the limiting value of reparations from the river fleet (20 per cent as constituted at the time of the armistice) fixed in the general reparations clauses (Part VIII, Annex III) had not been reached. It was prescribed that the barges should include all classes of tonnage in proportion to that of the vessels entering the port of Strasbourg in 1913, excepting barges of less than 500 tons. The tugs were divided between screw tugs of 2566 total horse power for navigating the

section between Duisburg and Rotterdam and side-wheelers of 21,194 total horse power for the section from Duisburg to Strasbourg.

Similarly for the docking facilities of the Rhine fleet. The decision of the arbitrator gave France the following advantages: entire ownership of a shipyard for coal transfer at Rheingau; at Mannheim a building and equipment for grain storage; at Ludwigshafen, Cologne, Duisburg-Ruhrort, and

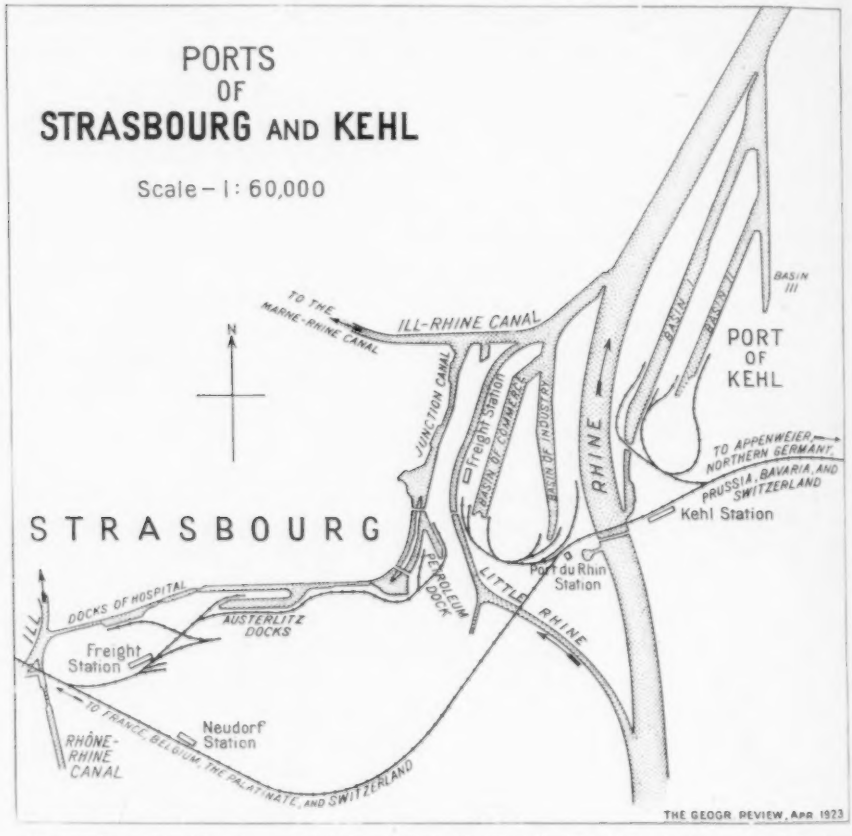


FIG. 7—The ports of Strasbourg and Kehl. After G. Haelling, "Le Rhin," map facing p. 171. According to Article 65 of the Treaty of Versailles the ports of Strasbourg and Kehl were to constitute for a period of seven years a single unit from the point of view of exploitation.

Rotterdam, use for 25 years of installations for storage or transit of considerable tonnage. Thanks to these facilities placed at its disposition, French navigation on the Rhine finds itself better equipped than any of the great German concerns: it equals in importance that of the great combine, the Kohlenkontor.

## IMPROVEMENT OF MEANS OF ACCESS

The problems concerning the ways of access are less easily solved. Besides the difficulties of connection between the different parts of the fluvial sys-

tem which have been described above, even in the improved sections traffic suffers from the taxes levied to pay off the cost of the works, from delays at the locks and waiting for cargoes in ports where discrimination existed in favor of the railroad, and from stoppages due to ice, low water, and the necessity of going into dry dock. These stoppages amounted on the average to 47 days a year on the Saar canal in the years 1897–1904; 63 and 62 respectively on the Marne and Rhone canals. On December 2, 1919, the French government promulgated a law for industrializing the Marne-Rhine canal system. The law provides for the maintenance of a reasonable amount of water from reservoirs built along the course and a diminution of delay by doubling the locks and broadening the narrow passages in the section from Vitry le François to Strasbourg and on the Saar canal. It is understood that the new locks will accommodate boats of 600 tons. It is with this 600-ton capacity in view that studies will be made for the canalization of the Moselle between Metz and Thionville, of the Orne, and of the Fentsch to assure a regular ore transport to Strasbourg.

Finally the Treaty of Versailles gives France the right to construct on her own territory from Strasbourg to Basle a canal paralleling the Rhine and to utilize the hydraulic energy to be derived from the fall of 100 meters obtaining between the two towns. This canal, which will be a waterway of the first order, will connect Strasbourg with the industrial sections of Mulhouse and Basle and, prolonged by a new canal of the necessary capacity for 600-ton boats, will assure connection with southern France.

The attention of the French administration has been equally directed towards the railways. Besides a doubling of tracks on the Paris-Metz line between Lérouville and Metz and on the Paris-Strasbourg line between Pont Saint Vincent and Blainville, which has for long been recognized as an indispensable step, the question of railways crossing the Vosges has been considered. At present this barrier is crossed only at the two extremities—by the pass of Saverne and the threshold of Valdieu. The cotton centers of Épinal and the cut-glass works of Baccarat are without direct communication with the Alsatian port. Plans for two lines—Saales-Saint Dié and Wesserling-Bussang—have been accepted, and work on them has already commenced; two others have been proposed which would effect a more central crossing—Sainte Marie aux Chênes-Saint Dié and Metzeral-Cornimont.

When these improvements of access are carried into effect Strasbourg will be able to command a trade of the tonnage we have stated. But its accomplishment will be dependent on enlargement of the port and its facilities.

## The Port

At present with the improvements under way the port can accommodate an annual traffic of 4,000,000 tons. A plan has been projected which will permit of an enlargement to 10,000,000 tons. This plan comprehends two

ports with free entrance on the Rhine: one the old harbor with the basins of Commerce and Industry, the other a new one to be constructed above the bridges joining Strasbourg and Kehl. The two harbors will be united by a canal with locks, the central part of which will itself constitute a very large basin; in addition are the docks of Austerlitz and a special petroleum dock under construction to the north of the present harbor.

Finally, with development of the maritime trade in view, Antwerp has been declared the outport of Strasbourg, and arrangements have been made accordingly. A surtax on bonded merchandise would mean the death of the Alsatian port, and all merchandise passing through the Belgian port is now exempt from dues. Furthermore, establishment of the Commercial Exchange will permit of regular direct transactions from over seas to Strasbourg.

## Conclusion

These changes and innovations demand considerable amounts of capital, but they will be productive investments. In 1913 the trade of the port reached 2,700,000 tons. According to our port statistics it would thus occupy sixth place—after Marseilles (8,100,000), Rouen (5,300,000), Bordeaux (4,000,000), Havre (3,600,000), and Dunkerque (3,100,000). But in giving assistance to Strasbourg the whole of France will be benefited. The economic influence of the port does not stop with the limits of the town or of the department. Even before the war merchandise could be shipped by Strasbourg for not a franc more than it would cost by way of Havre or Rouen or Marseilles. The Treaty of Versailles has enormously increased the commercial hinterland of the port, opening up to it the richest and most populous of French provinces. The port likewise can aspire to be a center of supply and a market for other nations, Switzerland and Italy upstream and oversea countries downstream.

"It is as a real Rhine power that France stands on the banks of the Rhine," writes M. Gaston Haelling. The port of Strasbourg is the bridgehead of this power.

# THE FORTY-FIFTH PARALLEL: A DETAIL OF THE UNGUARDED BOUNDARY*

By Lawrence Shaw Mayo

When James I granted the first Virginia charter in 1606, he found it necessary to set limits to the territory which he thus placed at the disposal of a favored group of his "loving and well-disposed subjects." The southern and northern bounds appointed in the document were 34° and 45° respectively; but why these parallels were selected can be only conjectured. All we know is that here is the first appearance of the 45th parallel as an American boundary. From this, one might be led to assume that the present northern limit of Vermont and New York—that shelf-like indentation in our Canadian boundary—finds its origin in the Virginia Charter of 1606. But such is not the case. Merely by coincidence is that line the same as the original northern boundary of James's Virginia. The true genesis of our international boundary from the Connecticut to the St. Lawrence is found not in an English but in a Dutch charter.

## Origin of the Forty-fifth Parallel as a Boundary

In 1614 Adriaen Block returned to the Netherlands after an interesting cruise along the American coast from Manhattan Island to Nahant, Mass. Thereupon the owners of the ship he had sailed and a few associates petitioned the Dutch government for a grant of land in those distant parts. With complete disregard for England's claim to the whole continent in general—and to her recent Virginia grant in particular—the States General of the United Netherlands granted to them, for three years, exclusive rights in North America between the 40th and the 45th parallels.[1] In this manner the Dutch for the first time defined their territorial claim in the New World and incidentally gave the undreamed-of states of New York and Vermont their present northern boundary. How the line persisted through the centuries is an interesting story.

For almost a hundred and fifty years the parallel was an international boundary, first between the Dutch and the French[2] and later—from the French point of view at any rate—between the French and the English. There are indications that the authorities of New France even went so far as to make observations and to locate the line.[3] Then came the Seven

* Following the general sketch of the history of the boundary between Canada and the United States, "The Unguarded Boundary," by J. W. Davis, in the *Geographical Review*, Vol. 12, 1922, pp. 585–601.

[1] Documents Relative to the Colonial History of the State of New York Procured in Holland, England and France by John Romeyn Brodhead, 10 vols., Albany, N. Y., 1853–1858; reference in Vol. 1, p. 11.

[2] *Ibid.*, Vol. 8, p. 3.

[3] *Ibid.*, Vol. 7, p. 874.

Years' War, the conquest of Canada, and the consequent giving of boundaries to the newly acquired province of Quebec. The last of these was accomplished by the Royal Proclamation of October 7, 1763.

### As an Interprovincial Boundary

Establishing a southern boundary for Quebec meant incidentally giving northern boundaries to New York and New Hampshire, including that disputed area known as the New Hampshire Grants. When France was on the north the British had done their best to forget the 45th parallel as a boundary. The farther north they could push their frontier towards the St. Lawrence the better.[4] But now the situation was different. A line was to be drawn separating two British provinces, and there seemed to be none more appropriate than the 45th parallel. So it came about that the latitude of 45° became the southern boundary of Quebec and the northern boundary of New York from the St. Lawrence eastward to—what point? Logically it should have run to the west bank of the Connecticut, for that was the eastern boundary of New Netherland as granted to the Duke of York by his brother Charles II in 1664. But for some inscrutable reason the Board of Trade chose instead to terminate it at the ridge of high land in eastern Vermont which divides the streams flowing into the St. Lawrence from those emptying into the Connecticut. Apparently the members of the Board were aware that the northern boundary of New Netherland was reputed to have been the 45th parallel, but they had not yet refreshed their memories as to the eastern limit of that domain. Feeling that they were free agents, they saw no reason why the parallel should continue as a boundary any farther than this St. Lawrence-Connecticut divide, which promised to make an admirable line of demarcation between Quebec on the north and New Hampshire and the province of Maine on the south. They drew the line accordingly, as the accompanying reproduction of one of their contemporaneous maps illustrates. The 45th parallel, from the St. Lawrence to the "highlands," was now established as an interprovincial boundary.

### Locating the Parallel

In the summer of 1766 Governor Moore of New York wrote to the governor of Quebec, suggesting that since the 45th parallel had been officially declared to be the boundary between their respective provinces it might be well for them to ascertain its location. As Moore intended to go to the Mohawk country sometime during that season for a conference with some Indian chiefs, he proposed that Governor Murray should come down from Canada and meet him at the northern end of Lake Champlain. There they would determine the line together. "I shall," he declared, "on this occasion endeavour to obviate any disputes which [may] arise in futuro, and shall not trust to my own skill and judgement, but shall take

[4] New York Colonial Documents, Vol. 8, p. 103.

with me the Mathematical professor of the College here, and a very fine instrument now in his possession, and every observation made will be in the presence of several Gentlemen of Fortune in this Province who have promised to attend me in this troublesome expedition."[5]

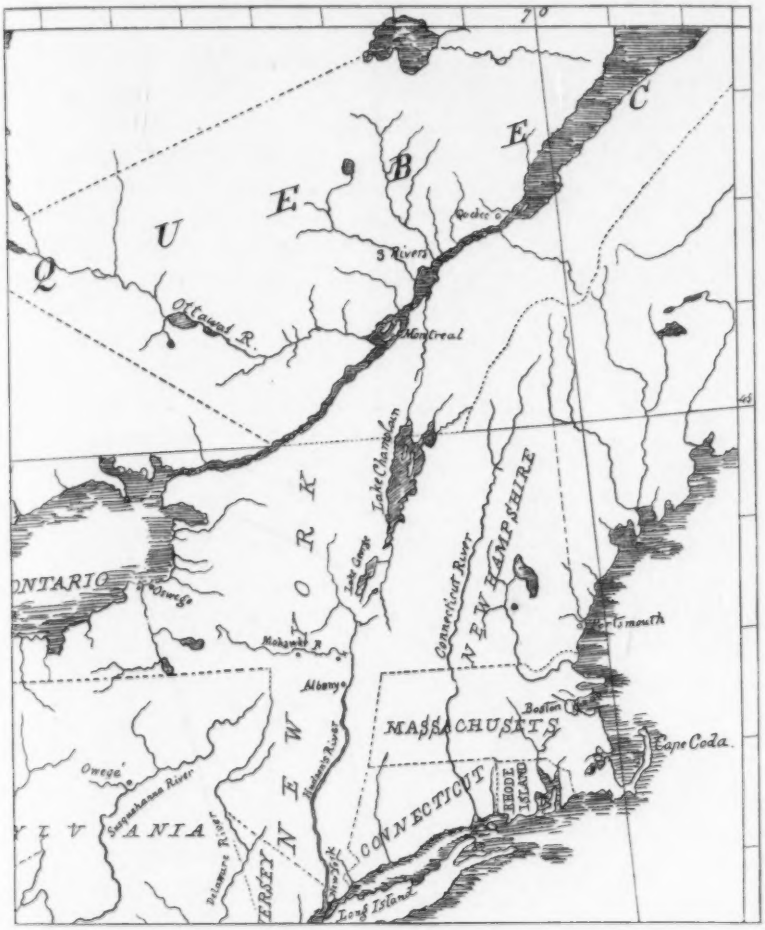


FIG. 1—Portion of a map accompanying a Board of Trade report dated 1768 and showing the northern boundary of New York and New Hampshire as established by the Proclamation of 1763. Reproduced on a slightly reduced scale from the map in "Documents Relative to the Colonial History of the State of New York," Vol. 8 (see footnote 1).

Since the governor of Quebec happened to be in England at the time, the business devolved upon the newly appointed lieutenant governor, Brigadier Guy Carleton, who went out to Quebec by way of New York. Soon after his arrival in the summer of 1766, Carleton and Moore set out together and in the course of time reached the northern end of Lake Cham-

[5] *Ibid.*, Vol. 7, pp. 850–851.

plain.[6] There they attempted to discover the location of the 45th parallel but were handicapped by two circumstances: bad weather and, to a greater degree, by a lack of agreement in the instruments used. Mr. Harper, "professor of Mathematicks for the Province of New York," who depended upon "an astronomical quadrant," placed the parallel five or six miles farther south than did John Collins, Esq., deputy surveyor for the province of Quebec, who worked with Hadley's quadrant.[7] This was rather odd, for in each case the man made his own province smaller than did his adversary—an occurrence which is perhaps unique in the history of boundary disputes.

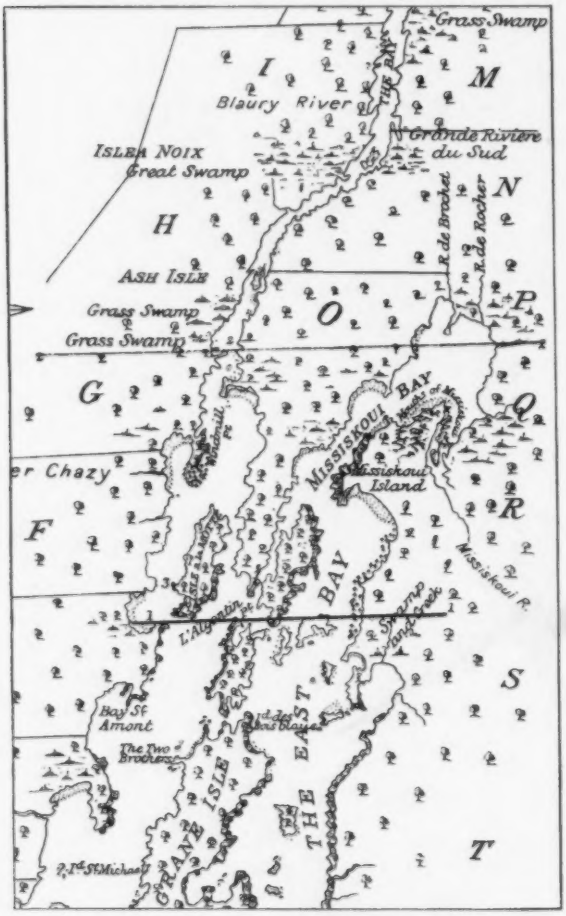


FIG. 2—Portion of the map "A Plan of Lake-Champlain" by Harper and Collins, 1766, showing the 45th parallel as located by each. Line 1 (south of Isle à la Motte) is drawn "agreeable to the first Solar Observation with the Astronomical Quadrant by Mr. Harper;" line 2 (south of Grass Swamp) "agreeable to the several Observations taken with Hadley's Quadrant by Mr. Collins." Reproduced on half the scale of the original, which is 4 miles to the inch (see footnote 7).

When instruments disagree, with whom shall the decision rest? In this case the quadrant with the greater reputation carried the day. This was Hadley's quadrant,[8] the Canadian surveyor's instrument, which, as we have observed, placed the 45th parallel at a point at least five miles farther north than the New Yorkers claimed. Thus the 45th parallel was located, and thus a starting point for the northern boundary of New York and of the

[6] New York Colonial Documents, Vol. 7, p. 874.

[7] Acts of the Privy Council of England, Colonial Series, Vol. 6, "The Unbound Papers," H. M. Stationery Office, London, 1912, Appendix ii, map 6.

[8] According to Adams's "Geometrical and Graphical Essays" (London, 1797), pp. 253–255, "Hadley's quadrant or sextant is the only known instrument on which the mariner can depend for determining with accuracy and precision his latitude and longitude. It is to the use of this instrument that navigation is indebted for the very great and rapid advances it has made within these few years."

New Hampshire Grants from the St. Lawrence eastward to the St. Lawrence-Connecticut divide was determined. So far, so good.

Between the time of the Proclamation of 1763 and the determination of the 45th parallel in 1766, the long-standing dispute between New Hampshire and New York concerning the territory now known as Vermont was definitely settled. By an Order in Council, issued in the summer of 1764, New Hampshire was unequivocally bounded on the west by the west bank of the Connecticut, and New York won her claim to the country between that river and Lake Champlain. According to the terms of the Proclamation, the northern boundary of this area was, as we have seen, the 45th parallel from Lake Champlain to its intersection with the watershed separating the rivers flowing into the St. Lawrence from those flowing into the sea. At that point, which is about twelve miles from the Connecticut River, the boundary parted company with the oft-mentioned parallel and pursued its sinuous course along the highlands, giving New York (Vermont) a short panhandle at its northeastern extremity.

## The Royal Confirmation

The 45th parallel having been located to the satisfaction of both governors, the next step was to obtain royal confirmation of their achievement. Moore, therefore, wrote to the Lords of Trade and in course of time received assurance from the Secretary of State that such confirmation would be forthcoming.[9] Nor was he disappointed, for on August 12, 1768, an Order in Council was issued confirming the 45th parallel as "mutually agreed upon between Sir Henry Moore and the Commander in Chief of the Province of Quebec."[10] But His Majesty, with the advice of his Privy Council, went further and ordered "that the said Line of Division be run out as far as each Province respectively extends."[11] This meant, of course, that the northern boundary of New York should thenceforth follow the 45th parallel from the St. Lawrence straight through to the Connecticut, paying no attention to the watershed between the St. Lawrence and the Connecticut Rivers and so giving to Quebec the panhandle which from 1764 to 1768 had been a part of New York.

The thing was done by the stroke of a pen and in all probability quite unintentionally. A careful search among the Colonial Office papers in London, at any rate, has yielded no evidence that George III and his advisers thought they were doing anything more than identifying the boundary which had been established by the Proclamation of 1763 and ordering that its course through the wilderness be traced. What they did, however, was to cut a few square miles from the top of New York (Vermont) and restore the ancient northern boundary of New Netherland as far to the eastward as the Duke of York's grant had extended.

[9] New York Colonial Documents, Vol. 7, p. 885; Vol. 8, p. 35.
[10] *Ibid.*, Vol. 8, p. 88.
[11] *Ibid.*, Vol. 8, p. 88.

### Running Out the Line Eastward from Lake Champlain

The 45th parallel was located in the summer or autumn of 1766. In August, 1768, was issued the Order in Council demanding that the line be run to the limits of each province. Two years more elapsed before definite steps were taken by the New York government to carry the order into execution. The winter of 1771, however, witnessed considerable progress in this direction. Lord Dunmore was now governor of the province. Early in February he sent a message to the Assembly urging them to provide for defraying one-half the expenses of running the New York-Quebec boundary; the other half, of course, would be borne by the Canadians. The Assembly responded promptly; and in the following summer Joseph Smith, representing New York, and John Collins, deputy surveyor general of Quebec, met on the shore of Lake Champlain. They began operations about the middle of August. Before the approach of winter obliged them to desist, Smith and Collins had run the "partition line" about twenty-two miles eastward from the lake. Their bill for "sundrys" is an interesting document. It totals £146 6s. 6½d. Of this amount the men's wages were £51 3s. A "Quarter Cask of Madeira" was £16; "Mr. Morrison's bill for Rum and Wine" was £10 7s. 4d.; six gallons of French brandy were £2 8s.; and they "paid the Cooper for Kegs and drawing off a Cask of Wine at Quebec" £1 1s. 7d. Yet some have marveled that the line they surveyed was so far from straight!

In the meantime Lord Dunmore had been succeeded in office by Governor Tryon. The new executive was almost unreasonable in his zeal to complete the running of the boundary. The winter had scarcely begun before he informed the surveyor general of New York that he should expect him to be on the Quebec line with his "assistants and attendants" on the first day of March to resume operations. Had the governor no heart? Or was he merely unacquainted with the climate of northern New York? Under the circumstances one can hardly blame the surveyor general for begging off. "As I have had several attacks of the Gout," he wrote to Tryon, "not only in my feet but likewise in my stomach, and dayly feel simptoms of it hanging about me I have great reason to be aprehensive that travelling and laying in the woods in the cold months of February and March might bring a severe fitt of that disorder again upon me which would not only retard the Service but would endanger my life."[12]

As the Governor did not insist that his surveyor general undertake the work in person, the latter found an agent in one Thomas Vallentine, for whom apparently the frozen north had no terrors. He was instructed to meet the Canadian surveyor and to "continue the same Line untill you arrive at the western Banks of the main Branch of Connecticut River that Crosses the Forty Fifth Degree of northern Latitude." Also "in running the

[12] The documents on which this and the ensuing statements are based are printed in the "Report of the Regents of the University on the Boundaries of the State of New York," Albany, 1884, Vol. 2, pp. 7–43.

said Line care must be taken to blaze the Trees on the East and west Sides as you pass along Cuting down only such Trees as stand directly in the sight of the Compass, and at the Distance of every three miles laying together a large Heap of Stones, and cutting a few knotches on the Trees nighest each pile of Stones."

In February, 1772, therefore, Vallentine set out for Lake Champlain. About the same time his associate, Collins of Quebec, who had been staying for a few weeks in what he termed "that miserable place Albany," also started north. The weather must have been unusually mild, for in crossing the lakes some of the horses of Collins's expedition broke through the ice and were drowned. This misfortune and a report that the ice on Lake George was covered with about a foot of water induced Vallentine to proceed slowly. Nevertheless he arrived at the rendezvous, "River La Cole," early in March and found Collins waiting for him. After a few days had been spent in organization, the party, consisting of Vallentine, Collins, and about twenty men, disappeared into the wilderness. Presumably they emerged about the middle of April, the streams becoming impassable at that season. Operations were resumed, however, towards the end of June; and on the last day of September, 1772, the expedition reached the Connecticut River "Two mile and five Eighth of a mile upon a Direct line above the mouth of Halls Brook, Distance ninety mile and one fourth of a mile from the Boundary fixed on Lake Champlain." "On the west bank of the river," wrote Vallentine, "we Put up a Squared Post and laid a quantity of Stones about it and had all the Trees and bushes for some distance around it cleared away to render it more conspicuous." Apparently he and Collins were satisfied with their achievement, as well they might be. The only complainants were the Indians through whose territory the boundary ran. "The Abenaku Savages are much displeased," Vallentine added, "with the course of the Line, say their Hunting Grounds are encroached on, and pull'd down a Post that we erected on the East Bank of Lake Mamraabagak."

## Westward from Lake Champlain

Then came the question of tracing the 45th parallel westward from Lake Champlain. In the winter of 1773 the Assembly authorized the governor to have this work undertaken. The Quebec government concurred, and the surveyors were directed to commence their labors early in June. It was intended that the personnel of the commission should be the same as in the previous year, but it turned out otherwise. In the middle of May, Vallentine was obliged to inform the lieutenant governor of Quebec that he would not be able to take the field until after the appointed time because of "a Bilious Complaint, attended with a Cholic in my Bowels, and a Lax, which in a few days reduced me to a very weakly Situation." With the assistance of Dr. Hope, however, he had happily obtained relief from the "Cholic" and expected to be a well man before the first of July.

The point of all these remarks was that he trusted that the running of the line might be deferred until he was able to be one of the party.

When the lieutenant governor of Quebec reported Vallentine's indisposition to Governor Tryon of New York, he supported his account with a very dismal certificate of Mr. Vallentine's ill health signed—ironically enough—by Dr. Hope. Whatever degree of sympathy the governor may have felt for Vallentine he agreed with his colleague at Quebec that the determination of the boundary was too important a matter to await the doubtful recovery of New York's agent. A substitute was appointed forthwith—a man named Sauthier; and he and Collins finally met on the west shore of Lake Champlain in August. By the middle of October they had run the line fifty miles westward. Then came the inevitable autumnal rains which obliged them to stop work until a more favorable season. Collins guessed that they had only ten miles to go and declared it to be "a great pity" that the line could not be completed then and there. But that seemed to be out of the question.

During the following winter Collins made the two provinces a proposition. He would complete the survey for a flat sum of £100. As he seemed to Governor Tryon to be "a gentleman in the integrity of whose conduct in the faithful performance of that service an entire confidence may be placed," New York accepted his offer and entrusted to him alone the location of the remainder of her northern boundary. Collins then proceeded and sometime before November, 1774, extended the line to the St. Lawrence River. At last, after six years, the provision of the Order in Council of August 12, 1768, had been carried into effect. The 45th parallel had been "run out as far as each Province respectively extends"—a phrase which had been interpreted to mean from the western bank of the Connecticut River westward to the St. Lawrence.

## Inaccuracy of the Survey

For more than twenty years the boundary established by Collins, Smith, Vallentine, and Sauthier stood unchallenged. In 1774 the British government extended it, on paper at any rate, to the eastern bank of the Connecticut as the southern limit of Quebec. In 1783, as a result of the American Revolution, it became an international boundary, and its eastern extremity was set at the middle of that river, or, according to New Hampshire's interpretation, at the middle of its northwestern tributary, Hall's Stream. In 1791 the portion lying east of Lake Champlain became the northern boundary of the new state of Vermont. But no one questioned the accuracy of the survey until 1796. Then a Mr. William Coit of Burlington informed the Vermont Assembly that he and Collins had examined the line and had found it well south of the 45th parallel. The Assembly took no action at this time,[13] but in 1804 Governor Tichenor agitated the matter again.

[13] Records of the Governor and Council of the State of Vermont, Vol. 4, Montpelier, 1876, p. 115, note 2, citing "Journal of the Assembly of the State of Vermont for 1796," pp. 113, 114, and 133.

At his instigation the Assembly in the following year passed an act empowering him "to employ some person of competent knowledge" to ascertain where the 45th parallel crossed Lake Memphremagog and also its intersection with the Connecticut River.

This Governor Tichenor endeavored to do. For the work in hand he engaged the services of the Rev. Samuel Williams, LL.D., of Rutland, whose chief claim to distinction lay in a history of Vermont which he had written and published in the previous decade. Among his contemporaries Dr. Williams enjoyed a considerable reputation because of his erudition, but let us hope that his historical writings were more accurate than his astronomical observations proved to be on this occasion. In May, 1806, Dr. Williams found the original wooden monument which Collins and Vallentine had erected on the Connecticut River in 1772. After taking a number of celestial observations he declared that the old line was 12′ 1″—approximately fourteen miles—south of the 45th parallel. Then he moved on to the east bank of Lake Memphremagog, where he went through a similar procedure and pronounced the existing line seven miles too far south. Assuming that the marker on the shore of Lake Champlain was placed correctly, he computed that the deviation of the line between that point and the Connecticut had robbed Vermont of more than 400,000 acres.[14] These facts—or rather fancies—he reported to the governor and returned to his parish in Rutland. On the other hand, about this time the provincial government of Lower Canada was receiving a number of communications which led it to suspect that the line was really north of latitude 45°. In 1807 the Canadian surveyor general made an official report in which he stated that the line was evidently crooked and that he believed it to be as much as three miles too far north at its intersection with the Connecticut.[15] It is not surprising, therefore, that when the War of 1812 was brought to a close in 1814, a clause was inserted in the Treaty of Ghent declaring that the boundary line from the Connecticut westward to the St. Lawrence had "not yet been surveyed" and providing for the creation of a commission to take charge of the matter.

## Efforts of the Commission Appointed under the Treaty of Ghent

The commissioners appointed were Thomas Barclay for Great Britain and Cornelius P. Van Ness for the United States. Their official meetings began at St. Andrews, New Brunswick, in September, 1816, and ended—in disagreement—at New York in October, 1821. The location of the 45th parallel was, of course, not the only problem which confronted them, but

[14] His report is printed in the "Report of the Regents of the University on the Boundaries of the State of New York," Vol. 2, Albany, 1884, pp. 46–49, and in "Records of the Governor and Council of the State of Vermont," Vol. 5, Montpelier, 1877, pp. 454–455.

[15] See the article "Northeastern and Northern Boundary," *North American Rev.*, Vol. 33, 1831, pp. 262–286; reference on p. 282.

it is the only one which concerns us here. The information laid before the commission was indeed disconcerting. In the autumn of 1818 both the British astronomer and his American associate discovered that the true 45th parallel lay about three-quarters of a mile south of the "Old Line."[16] Except for its effect upon the reputation of Dr. Williams this discovery would not have been so disturbing, if the United States had not recently constructed a fort on territory which now appeared to be British. The fort stood on Rouses Point, a commanding peninsula at the northern end of Lake Champlain. It was about a half-mile south of the "Old Line" but clearly north of the true parallel. The astronomers were horrified and at first kept very quiet about their discovery lest it should precipitate a local uprising. Further observations made it evident that the Collins-Vallentine line was inaccurate and erratic throughout its course.

The American agent, William C. Bradley, whose duty it was to present the American argument to the commission was in desperation. There was no longer any doubt as to the true location of the 45th parallel; but something must be done to save the fort for his country. As the eighteenth-century boundary had been the work of provincial officers carrying out the instructions of the British Crown, Bradley's first argument was that it should stand, regardless of the true 45th parallel. If the commission would not agree to this he declared he should be obliged to argue in favor of the *geocentric* latitude, as distinguished from the *observed* latitude, which would throw the parallel thirteen miles farther north.[17] The commissioners could not agree upon his first suggestion. As to his second, both agreed that it was preposterous!

In accordance with the terms of the Treaty of Ghent, therefore, the matter was now referred to an arbitrator.

## Decision of the King of the Netherlands as Referee

The King of the Netherlands was the arbitrator agreed upon by Great Britain and the United States. After three or four years of deliberation he made his award on February 10, 1831. To him it was clear that the best solution of the 45th parallel difficulty would be to adopt the true line with the exception of a bit of territory near the fort at Rouses Point. There an arc with the fort as its center and a radius of one kilometer should be described. All the territory included therein should be given to the United States. From a distance of ninety years this recommendation appears as fair as it was ingenious. Unfortunately, the terms of the arbitration called for a judgment for one side or the other and did not authorize the recommendation of a compromise. The British government was ready to accept the arbiter's proposition, nevertheless. But not so the Senate of the United States. By it the award was repudiated in July, 1832.

[16] J. B. Moore: History and Digest of the International Arbitrations, to Which the United States Has Been a Party, 6 vols., Washington, D. C., 1898; reference in Vol. 1, p. 80.

[17] *Ibid.*, Vol. 1, p. 112.

## The Webster-Ashburton Settlement

Another decade passed, and the northern boundary of Vermont and New York remained undetermined. In the meantime, however, the lack of a definite frontier for the state of Maine and other causes of friction between Great Britain and the United States made necessary a new treaty between the two countries. Happily for the young republic its part in the negotiations was carried on by Daniel Webster. He had accepted the office of Secretary of State in President Harrison's cabinet in 1841 and after Harrison's untimely death continued at the head of foreign affairs under the succeeding president, John Tyler. Webster was convinced that the proper method of establishing the northeastern boundary, including the 45th parallel, was to agree upon a conventional and arbitrary line. When his sentiments became known in Downing Street the British government greeted them with favor and sent Lord Ashburton to Washington to settle the question on this basis. He arrived at the American capital in April, 1842, and the negotiation began forthwith. As a result of their policy of give and take, Webster and Ashburton created a northeastern boundary that proved satisfactory to a majority of all concerned. The northern limits of Vermont and New York were finally set, not at the true 45th parallel but along the inaccurate, eighteenth-century line of Collins and Vallentine. Thus seventy-five years after Governors Moore and Carleton erroneously located the 45th parallel on the shores of Lake Champlain, and almost seventy years after Collins completed their work by running the line of division to the extremities of both provinces, that line—and not the limit set forth in the Treaty of 1783—became the legal international boundary from Hall's Stream, the northwestern tributary of the Connecticut River, to the St. Lawrence. And thus did error ultimately triumph over accuracy.

When the government surveyors entrusted with the exploration and marking of the boundary established by the Ashburton Treaty came to the Collins-Vallentine line they identified it by the blazes still remaining on the trees of the forest. To verify the evidence they cut into some of these marks and found scars deep-seated in the trees. By counting the rings from these scars to the bark they computed that these were indeed the original blazes made by Collins and his associates in the early 1770's! Their report upon the relation of the line thus determined to the true 45th parallel will complete the story.[18]

"The boundary along the west line, though very far from being a straight line, is generally about half a mile north of the true parallel of latitude 45°, from Hall's stream [of the Connecticut River] to Rouse's Point. At about twenty-eight miles west of Rouse's Point it, however, crosses that parallel to the south, until it reaches Chateaugay river, where it bends northwards, and, crossing the parallel again, about four miles east of St. Regis, it strikes the St. Lawrence one hundred and fifty-one feet north of 45°."

[18] *Senate Exec. Doc., No. 71, 30th Congr. 1st Sess.*, p. 8.

# THE GEOGRAPHICAL STUDY OF POPULATION GROUPS*

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## How Population Is Studied

The literature of population is relatively small. To realize this, one has only to consult the subject index of a large library. The important works on the subject start with Benjamin Franklin and Malthus and run down through the nineteenth century fairly regularly, ending with Carr-Saunders in 1922. The uniform character of the investigations is very striking. They nearly all deal with the matter from the standpoints of statistics, economics, or eugenics. Geography is not represented.

A vast knowledge of the distribution of man on the earth has accumulated during the statistical period. His preferred habitats are thoroughly known; his rate of growth in them is known; and the general nature and trend of his movements from place to place are known. The numerical study of man is on a sound basis and has been exhaustively investigated by the mathematicians. Nations can hence compare themselves with other nations in a rigorously quantitative manner and are now psychologically dominated either by the fear of numerical inferiority or by the pride and strength of numerical advantage.

Political economy has analyzed the growth of mankind and is able to show that subtle relations exist between occupation and rate of increase, between the industries of peoples and the fecundity of certain classes of human beings, between national revenue and prosperity as measured by numbers; and has shown that national wealth and power are in a great measure functions of the resources of the national or imperial land bases. "Be ye fruitful and multiply: seize the good places of the earth and use them!" This advice has been followed with an intensity that may well be regarded with anxiety.

The eugenists have examined the conditions of life and the quality of the human harvest. They are dissatisfied. They see the squalor and poverty of the towns and cities and the deterioration of mind and physique among slum dwellers. They note that along with increasing wealth and progress is a parallel development of misery. Eugenic study has produced two very active campaigning minorities: the advocates of preventive checks of population growth and the town planners. The latter need only a knowledge of the existence of the field in order to become geographers. Thus far has the study of population brought us. We have a majority faith in the desirability of numbers and a minority apprehension that quantity is lowering quality.

* Read before the Association of American Geographers, Ann Arbor Meeting, December, 1922.

Among the qualified prophets there is no unanimity, but they incline towards a faith in numbers.

## What Has Geography Done?

If the geographer be asked for succinct and useful information on population he is able to point to endless tables of figures taken from the statistician. He is able to produce innumerable maps of the world, of countries, regions, and districts, showing the density of population depicted according to arbitrary administrative subdivisions. He can point to the fact that more people live on the coal fields of Westphalia, or the alluvium of the Ganges, than on the veld. The facts are interesting, and the reasons rather obvious. He can produce curves showing the growth of all the leading cities of the world and can tell you just why Detroit has grown, if you don't happen to know. He can tell you anything about numbers, provided you ask him to deal with them under the subdivisions of cities, towns, and "remainder." The maps, except those of Sten De Geer (admirable, expensive, and difficult to file), are not geographic maps. Inevitably their information as a whole or in detail is generalized and lacks precision. For the merchant the geographer has handy information on the habits and occupations of all the peoples of the globe and can point to markets.

The coherent and obvious population groups have been studied in their relation to the configuration of the land, and a large amount of information exists about the positions of cities, the sites of towns and villages, and the locations of dwellings. This information has not yet been treated exhaustively and has yielded few principles. It is useful and indicates a lead to one of the objectives of science—prediction. It is known that Paris has grown because it is in the right place; that the villages of Macedonia are often definitely related to fault scarps; that the Mormon communities of Utah have wisely placed themselves on the fans at the canyon mouths. Numerous towns have been studied as objects in the landscape, with fruitful results. The town is seen to be composed of definable units, and we are coming to understand their interdependence and to control their growth. These studies, however, are in their infancy.

During the past twenty years the regional movement has asserted itself as a definite policy in geography and bids fair to spread to other sciences such as climatology, biology, and even sociology. The subdivision of the earth into regions is the beginning of a reliable stock-taking of world resources. The configuration of the globe determines its occupation by mankind. The climatic limitations of the region will eventually determine who shall be the occupant. The climatic limitations also control the natural fecundity of the region in plant and animal products. The regional view will show us the deficiencies and surpluses of the various parts of the earth and will enable us to understand our final interdependence. The capacity of the region will set a limit to its use.

The status of the region is still in debate. Some deny the reality of its

existence. Others hold that delimitation cannot be placed on workable principles. Still others dispute the criteria of unity which have been selected. Nevertheless, the regional movement is steadily gaining adherents from the soundest ranks of geography, and the subdivision of the globe into world regions, climatic regions, physiographic provinces, and natural districts may, I think, be confidently expected in the near future. It can only be done satisfactorily by a survey method, and the existing regional maps are no more than the results of reconnaissance and reasonable speculation.

The results for geography, then, are slight, the ground being barely broken. Little definite information is in existence, and no useful contribution to the population problem can be made at present. The line of attack, however, is discernible. I am aware of only one attempt at a direct contribution to the problem by a professed geographer.[1]

## The Geographical Confrontation

We know where the people of the earth are. We know in some measure why they are there. We know what enables them to live there. Can we say how many will be able to maintain themselves in a given region? And under what conditions?

These, it seems to me, are the geographical objectives in the investigation of the population problem. But how is geography to confront the problem, and with what equipment is it armed? The investigator needs a philosophy of population. Is he to be a champion of uncontrolled increase and ruthless exploitation of the earth, or of controlled increase, if that be possible, and a wise use of resources? His opinion will be based upon the conclusions of the economic investigators, modified by his own geographical knowledge. The conclusions of the economists, however, are strongly tinged with nationalism or colored by national environment.

In the United States we find Thompson[2] aligned unequivocally with Malthus and regarding France as the well-advised and fortunate follower of a sound doctrine. His position, based on a careful interpretation of Malthus, from first-hand and intimate knowledge, is a very firm one. He is strongly supported by East, whose argument is the result of an extensive inquiry into the agricultural resources of the country.[3] East has estimated a maximum capacity for the United States, under conditions like those of the present, and his results are in striking accord with those of Pearl and others, who arrive at a principle of population maxima from the mathematical interpretation of increase regarded as a growth phenomenon.[4]

[1] G. G. Chisholm: Geography and the Population Question, *Geogr. Teacher*, Vol. 9, 1917–18, pp. 54–57.

[2] W. S. Thompson: Population: A Study in Malthusianism (Columbia Univ. Studies in Hist., Econ., and Public Law, Vol. 63, No. 3), New York, 1915; reference in Ch. 9.

[3] E. M. East: Population, *Scientific Monthly*, Vol. 10, 1920, pp. 603–624; *idem*: The Agricultural Limits of Our Population, *ibid.*, Vol. 12, 1921, pp. 551–557.

[4] Raymond Pearl and L. J. Reed: On the Rate of Growth of the Population of the United States Since 1790 and Its Mathematical Representation, *Proc. Natl. Acad. of Sci.*, Vol. 6, 1920, pp. 275–288.

Raymond Pearl and F. C. Kelly: Forecasting the Growth of Nations, *Harper's Mag.*, Vol. 142, 1921, pp. 704–713.

In France economic propaganda are vigorous at the present time, the slogans being "avoir beaucoup d'hommes; faire rendre le maximum à la terre; fabriquer à force de machines; étendre le commerce de mer; associer les colonies à l'effort national." These measures are advocated by Demangeon,[5] and an elaborate argument for the increase of French population by increasing French production has been put forward by Lascaux.[6] He shows that production and population are undoubtedly linked intimately and concludes that France must have more people and can only do so by feverish efforts at production. The French economists are almost unanimously anti-Malthusian, their condemnation of the pioneer resting upon criticism of the arithmetical ratio. The leaders of France demand a great population, but the French people pay little heed to them. The demand seems to spring from a fear of the wealthy and populous nations. And yet France is a happy and prosperous country; and, moreover, the land of France is full. Tillage has expanded until there is little ground left to till, and the land seems to be occupied by a maximum of people. I have only seen this view expressed in print once and that in a volume on birth control which contains several very illuminating essays.[7]

The English interpretation, as expressed in an important work by Carr-Saunders, aligns itself in some measure with that of Pearl. It implies that these things are operating according to some law and that they will, in a way, look after themselves. Carr-Saunders looks to the development of an optimum density of population, changes in numbers coming about in response to economic requirements. Increase of population brings industrial returns up to their optimum, if they are below it, and vice versa. This may well be true in an isolated and closed system and in its broadest sense may be true as a whole, but one may query whether or not the condition of optimum returns is desirable or whether the adjustment from conditions that have gone past the optimum is a comfortable process.[8] A different viewpoint is exhibited by Darwin, who evaluates civilization according to the possession of wealth, stock, and tradition, recalling Fleure's three aims of humanity, life, new life, and good life. Darwin makes a reasonable deduction to show that civilization depends ultimately on wealth and concludes that "any increase in our numbers must, therefore, now react injuriously on our civilization, both directly by lowering average natural endowments and indirectly by causing a diminution of average wealth."[9]

Those who have watched the world filling up, who have seen the colossal efforts that were required to feed England during the war, who have considered the delicate balance of world economics and realize how easily that balance is upset, who foresee the growth of the exporting countries and the probable diminution of their ratio of export, who have studied the exodus

[5] Albert Demangeon: Le déclin de l'Europe, Paris, 1920, p. 294.
[6] Robert Lascaux: La production et la population, Paris, 1921.
[7] Population and Birth-Control: A Symposium, edit. by Eden and Cedar Paul, New York, 1917, p. 294.
[8] A. M. Carr-Saunders: The Population Problem: A Study in Human Evolution, Oxford, 1922.
[9] Leonard Darwin: Population and Civilisation, *Econ. Journ.*, Vol. 31, 1921, pp. 187–195.

from countries endeavoring to arrive at their optimum density of population after having exceeded it,[10] will most likely agree with Mackinder, that the oceans of the world are now a closed sea, and will incline towards a Malthusian view of the population problem. Dr. Fenneman said before this Association in New York in 1921 that "the world is filling up, and the time is coming for Africa to do its share in providing food." World population is increasing at a very rapid rate, and the most conservative estimates of future populations render the prospect of feeding them a very formidable task. No matter what laws the increase will obey, geography confronts the questions "Where are all these people going to live? How are they going to live? and What resources can be made available for their sustenance?"

## The Population Groups

Professor Barrows in his presidential address used the term "human ecology." The study of population groups is precisely this and is hence a biological investigation. "We are concerned with the interactions between society and its surroundings. Society, the collective organism, is the highest expression of the organism, and for its own maintenance it sets aside organic groups, largely expressed as towns and cities. These may be examined according to function (physiologically), according to form (morphologically) as Fleure has done, or according to tissue (histologically)."[11]

In size, the elements of the groups range from the conurbations of Geddes down to the isolated families of rural districts of dispersion. The group itself is the intimate expression of its region and in many examples exhibits a marginal fusion, or dovetailing, with the groups of neighboring regions. This relation does not obscure the limitations of any but the largest groups but rather rings them round and accentuates them with a solid frontier. The town is not generally the group, nor is the cluster of farms of a particular district the group; the group itself is the sum and spread of all dwellers of the region. Hence I have said above that the groups are largely *expressed* as towns and cities. The town or city points to the existence of the regional group. The clusters are always there, but the density of the halo is subject to great regional variation. In some regions, as, for example, where the regional effort takes the form of isolated mining, the halo may be entirely wanting; and at the other extreme, as on many coal fields, density may be uniform and high, as in cities, with here and there a barely recognizable centralization point or core. For these reasons I have used the term "grouping of population" to denote the regional distribution of humanity and "arrangement of population" to express the disposition of peoples forming the internal elements of the groups. Jefferson's maps, particularly of the cities of the United States, appear to me to be the first steps towards a recognition of the knotting points of the groups of the country. Careful distinction must be

[10] See "The Migration of Races," *The Round Table*, No. 42, March, 1921, pp. 241–273. London.

[11] M. Aurousseau: Urban Geography: A Study of German Towns, *Geogr. Rev.*, Vol. 11, 1921, pp. 614–616; reference on p. 616.

made between elements which exist for the service of groups of lower rank and those which exist for the service of a higher group or of groups which embrace the lower. As all the elements of a group occupy position in space, an element serving a major group must occupy a position within a lower region and may easily be mistaken for an expression of the lower region.

The town represents the culminating point of the highest activity of the group. It exists for the *production* of the results of the highest effort of which the group is capable, whether the effort be in a material or an intellectual direction or in the direction of the broadest social service. A health resort exists for social service; so also does a major traffic town. The town is thus an evolutionary development from the lower grades of production—the grades which are essential in order to maintain the existence of life. The town takes its strength from the producing capacity of the region and from its relation to the route. In a small region, say one of the Belgian natural districts, we find the central town, or district capital; the subordinate towns, evenly scattered, "en pleine région;" and, if neighboring regions be of a contrasted character, the marginal towns of the border fusion. These marginal towns, or *interregional towns*, are clearly exhibited by several Belgian districts. Between the district of the "plaine maritime" and Flanders proper we find Bergues, Furnes, Dixmude, and Bruges. Between Picardy and Flanders is the line of towns St.-Omer, Aire, Béthune, Lens, and Douai. Between Brabant and the Campine we have Malines, Louvain, and Tirelmont. Some of the towns of the fall line of the Atlantic seaboard are in this sense interregional towns. Thus, in regarding the town as a regional knotting point, distinction must be made between the central towns, the towns "en pleine région," and the interregional towns of the margin. A map of the towns of a country cannot, therefore, be used as an immediate index to the distribution of regional groups; and, before the regions can be represented with any certainty on the map, a much deeper study is required.

I am not aware of any studies dealing with population groups according to their relation to the region. Yet this treatment seems to be a necessary beginning for a physiological interpretation of the groups. In the first place we do not yet know the extent or nature, particularly, of our smaller regions. Some attempts have been made to delimit the climatic regions and physiographic provinces, and maps showing the *proposed* subdivision of the United States on these grounds are in existence. The geographic sense hints at the direction in which an interpretation may be sought. Let us take the town map of the United States and *remove* from it all cities and towns existing in the service of the larger groups. The *port* of New York serves the whole country and has but little to do with its immediate region. Salt Lake City is certainly the property of Utah, but Denver belongs to more than Colorado. Examination of the depleted map, examination of the ground, where possible, and a somewhat extensive questionnaire, say through the universities, will serve to indicate the capitals, "villes en pleine région," and interregional towns of the smaller regions. Regional survey alone will be the final test of

the truth of a map constructed by these means, and it may be long deferred.

The occupants of a geographic region, then, constitute the population group. The groups of the smaller regions are integral parts of higher groups corresponding to regions of higher status, while the largest groups are influenced strongly in their development by the restrictions of nationality and the existence of political boundaries, which tend to complicate or to obscure the geographical relationships of the group. The regional treatment of the group will help to clear the ground of many difficulties. We are accustomed to speak of urban and rural peoples, for example, but hesitate to draw the line of division between them. They stand at opposite poles of the occupational series of which the group is composed, but there is seldom a true line of division between them. Professor Jefferson once said to me "the country has now delegated many of its duties to the town," and this modern delegation of duty has done much to make the transition from rural to urban activity a very gradual one. In past times it was much more clearly defined than it is now.

The group, as a regional unit of population, has not been studied. We are in possession of a great deal of information concerning the effects of environment (Miss E. C. Semple's work, for instance, is very widely known) and of the relation between climate and civilization, a contribution in the main from Ellsworth Huntington; the profound effects of geography on the course of history have been made evident by Mackinder; and the anthropologists have readily admitted and made use of the geographical factor as a determinant in race development.[12] In none of this work has the region been made the unit, and a physiological investigation of the regional groups of lower status must be the beginning of a satisfactory geographical study of population.

## The Elements of the Regional Groups

If geographers have not examined the group as a whole, they have given considerable attention to the elements of the group, particularly to the towns and cities. Most of this work has been individual, specialized, isolated, and in general is of morphological or histological character. The town planners have long looked upon the town as a functional element, and I have myself endeavored to supply a classification of towns according to their functions;[13] but in general the functional interpretation is not apparent. An approach towards a morphological, regional attitude in town studies is to be seen in the work of Geddes, Fleure, and Geisler;[14] and Geddes in particular has given us the useful conception of conurbations, or regionally grouped cities. The effort of geography has been confined, however, largely to rather

[12] See A. A. Mendes-Corrêa: Le milieu géographique et la race, *Scientia*, Vol. 30, 1921, pp. 371–380.

[13] John Nolen: New Ideals in the Planning of Cities, Towns, and Villages, New York, 1919.

M. Aurousseau: The Distribution of Population: A Constructive Problem, *Geogr. Rev.*, Vol. 11, 1921, pp. 563–592.

[14] Patrick Geddes: Cities in Evolution: An Introduction to the Town Planning Movement and to the Study of Civics, London, 1915; reference in Ch. 2.

H. J. Fleure: Some Types of Cities in Temperate Europe, *Geogr. Rev.*, Vol. 10, 1920, pp. 357–374.

Walter Geisler: Beiträge zur Stadtgeographie, *Zeitschr. Gesell. für Erdkunde zu Berlin*, 1920, pp. 274–296.

detailed morphological and histological investigations of individual cities. The results have appeared mostly in volume form; and we are in possession of valuable works on the geography of Rouen, Marseilles, Grenoble, Danzig, Edinburgh, New Orleans, and other cities. This work is making clear the units which compose the modern city but is not yet susceptible of yielding anything from generalization. We are prone to regard the city as an entity, rather than as a culminating point of regional effort. We speak of Athens and forget that it was the product of the Attic plain; of Rome, ignoring its base in the Campagna; of Carthage, to the exclusion of the numerous smaller Carthaginian towns and of the agriculture of the Punic region. London alone is called "the hub."

A great deal of information concerning the positions and sites of towns and cities is easily accessible in the literature of geography and in the hands of Mackinder has yielded a most fruitful generalization in his conception of nodality. It throws great light on the underlying causes of the prosperity and decline of towns, and in competent hands it enables a wise choice of the positions of new cities to be made. The new capital of the Australian Commonwealth was "placed" by a physiographer. The principle of nodality is related to the function of the town, urban activity standing in close relation to the degree of nodality of the position.

The elements of lower-grade production within the group, the so-called "rural populations," have also been studied; and their arrangement within the region is found to be closely related to the geographic nature of the region. The region will permit them to occupy it in a certain way if their social and economic development has allowed them to come to what may be termed geographic freedom. They *tend* to occupy it in this way; and, where freedom has been attained, the region is found to exhibit domains of characteristic arrangement.[15]

At the present time all stages towards geographic occupation are to be seen among rural peoples. Those who have attained freedom endeavor to occupy the region "as they like" and are found to occupy it as the region permits. All stages, from the primitive cluster towards various kinds of dispersion, are to be seen; and some regions do not permit of any other than a clustered arrangement. The best method of occupation of others is undoubtedly some form of dispersion, and this has not been taken into account by the rural reconstructionists, who demand new and better *villages*.[16] The factors which tend to maintain the primitive cluster are diverse but are nearly all economic or social in their nature. They point to stages in the evolution of society. Sometimes, among primitive folk, they are psychological and curious. In the Grenadines, for instance, the negro population of

[15] M. Aurousseau: The Arrangement of the Rural Population in Picardy and Flanders, *Geogr. Journ.*, Vol. 51, 1918, pp. 393–394.
*Idem*: The Arrangement of Rural Populations, *Geogr. Rev.*, Vol. 10, 1920, pp. 223–240.
*Idem*, *op. cit.*, footnote 13.
Marguerite Lefèvre: Carte régionale du peuplement de la Belgique, *La Géographie*, Vol. 36, 1921, pp. 1–34.
[16] Harold Peake: The Regrouping of Rural Population, *Geogr. Teacher*, Vol. 9, 1917–18, pp. 71–77.

the island of Carriacou is dispersed over the plantations. On the neighboring territory of Union Island, however, the negroes, similar to those of Carriacou in every respect, are (or were, the island having been swept by a hurricane) huddled into the two small towns of Ashton and Clifton. Union Island is infested with ghosts, and the only way to "fool" the ghosts is to live as close to your neighbor as you can possibly get.[17] Similar beliefs were a stumbling block in the German efforts to induce the natives in East Africa to replan their villages on more open and sanitary lines.

Considerations of rural arrangement, adapted to geographic conditions, lead one to the conclusion that there is a regional limit of capacity for occupation; and I have advanced the idea of the regional expansion ratio, as a quantity capable of evaluation by proper survey. Can more than a given number of rural people live in a given region? I think not. The expansion ratio should answer the question definitely. Its workability, however, remains to be proved.

Recognition of characteristic rural arrangements is only attainable on intimate knowledge of the region. Indeed, realization of the extent and nature of the region itself depends on a close and long first-hand knowledge of a particular territory. Where these conditions have been realized, the regional scheme has in every case betrayed itself; and it is on these grounds that a personal belief in the region is founded. After two years' residence in the District of Columbia, I have only recently recognized that a very well characterized arrangement of the rural population exists in the environs of Washington. It is a hilltop dispersion, closely associated with the development of ridge routes. Good topographical maps often suggest the key to the arrangement; and Miss Lefèvre's work in Belgium was based largely on the official maps of 1: 100,000 scale, which is a very workable scale. My own results have come from examination of the ground, sometimes prompted by a suggestion from the map.

## The Historic Development of the Group

It is from a systematized knowledge of the structure and function of the group, and of its historic development in its region, that a useful geographical contribution to the population problem is likely to come. How have the group and its region interacted in past times? At present we cannot say, but there are definite indications which point the way; and our first attempts must be made on the old and long-settled countries.

In Europe a mass of information and a large number of statistical estimates concerning the population of past times have been collected by the economists, and anthropologists and others have studied the origins of race and types and causes of early settlement. In Europe, moreover, population has been tied to the soil for long generations; and the most noteworthy movement has been one of exodus rather than one of internal movement, as in the

[17] Oral communication from Dr. Austin H. Clark.

United States. Moreover, in Europe, especially in France, regional study is more advanced than elsewhere, there being a large number of papers in European geographical literature dealing with particular regions. In other words, the conditions of occupation have been relatively stable, and the regional knowledge is greater than in newer countries. The old social and economic organizations, like the village communities of Europe and parts of Asia, also possess a fairly extensive literature, which is of service to the geographer. From this last source much may reasonably be expected.

## The English Village

Peake has very recently published a most comprehensive volume on the English village, from which important inferences may be drawn.[18] The village community is traced to its earliest sources, and its prototype is seen by Peake in the Alpine lake dwellings of Switzerland. From the lake dwellings sprang the nucleated village, while the dispersed village, later giving rise to the forest village in England, seems to have originated in the forested plains of Germany. The appearance of each social form in England is traced as far as knowledge permits, the modification of the form being followed in detail and ascribed mainly to racial influence. The numerous anthropological types to be found in the village itself and in the region are tracked to the distant lands of their origin. The initial geographical implication is the intimate connection existing between the village and its area (the township). The village site is given comparatively little attention; but, assuming a site to have been chosen for whatsoever reason, the community in, say a valley village in Saxon England, was dependent, through its organization, upon the possession of meadows, common fields, and waste. The surrounding lands were appropriated up to the limits of these requirements. But sooner or later there were neighboring villages. Boundaries were set to the township, and gradually its whole area became involved in the economy of village life. We must suppose that these boundaries were selected with regard to the ease and stability of their maintenance and had, therefore, certain physiographic determinants. We suggest to the English student of rural geography that there is an interesting problem awaiting investigation here. Moreover, the village had many affairs with the outside world, and to deal with them townships combined into hundreds; and we may surmise that the areal form of the primitive hundred was based upon convenience. The union of hundreds into shires would follow the same scheme, though less rigidly. We deduce that the village was a *growing* thing in a *limited* area and stood in definite relation to the smallest of geographic entities, the natural district. These ancient boundaries may give us the key to the natural districts and natural regions, where human modification has obscured their reality from the modern world. The village felt its first growing pains in the tenth cen-

[18] Harold Peake: The English Village, The Origin and Decay of Its Community: An Anthropological Interpretation, London, 1922.

tury,[19] according to Peake. Adjustment was made by decreasing the size of holdings in the common fields from 120 acres, which is believed to have been the Saxon standard (per family), to about 30 acres. From then, decrease in the size of holdings became progressive. After the Norman Conquest very little beyond the nomenclature and the perspective was changed. The township became the manor, with practically the same boundaries and little change in organization, and, whereas to the Saxon the township was the unit and the kingdom a combination of townships, to the Norman the scheme was reversed; the kingdom was the unit, subdivided into townships on a military basis. The settled Norman rule led to more growing pains in the eleventh century. These were met by building more houses, which limited the extension of the common fields, and by encroachments on the waste (pasture).

The Statute of Merton (1235) is regarded by Peake as a turning point in the history of the village. The lord, prior to the tenth century, had been a guardian of the waste. Thence on, his position of trust insidiously became one of ownership, an ownership actually legalized by the statute. Immediately large areas became privately enclosed; mansions were erected far from the villages; a severance of interests began. The village of the twelfth and thirteenth century showed marked signs of pressing seriously upon its means.[20] Combination of townships, irregularity in the sizes of holdings, the presence of assarts (enclosures of the waste), the law of stint (limitations of the rights of pasturage), and more acute restraints on the peasant, such as license to marry or to sell his oxen, all point to embarrassment of the village through increase of population in an area incapable of extension. Furthermore, towards the end of the twelfth century the old plowlands, through lack of proper manuring, were deteriorating in value.

The gradual substitution of renting tenure for servile tenure, the expansion of pastoralism, and the consequent pressure of the landed gentry on the agricultural folk, the final calamity of the Black Death, and a general decrease in soil fertility appear to have brought about the long train of enclosures which extinguished the village community. Little remained of the old system but its shadow—the ecclesiastical parish, which succeeded the manor. Peake ascribes the enclosures of the sixteenth century mainly to the spread of pastoralism, and he implies a certain depopulation of the villages (through eviction) and congestion of the rising towns (e. g. Newbury, Berkshire, 1517). From the sixteenth century onward the English village, from a geographical standpoint, loses steadily in definition. As a social entity it ceases to have much significance. As a geographical form Peake says nothing of its further modification though it is demonstrable that the movement towards free geographical arrangements has taken wide effect. The rise of

[19] As might be expected, this process of expansion made itself felt somewhat earlier on the neighboring parts of the continent (ninth century). See Marguerite Lefèvre, *op. cit.*, footnote 15, pp. 21–23.

[20] About this period (and for some time later) the final clearing of the forests and reclamation of the marshes was being accomplished in Belgium. See Marguerite Lefèvre, *op. cit.*, footnote 15.

The towns of Germany were also realizing the need of space for growth and were making allowance for it in their plans. See Walter Geisler, *op. cit.*, footnote 14.

the parish, in response to the need of administering the poor laws, is followed, and some interesting information concerning parish boundaries is given.

That the fluctuations and changes of the rural peopling of England were regional in character is fairly inferred from several sources, particularly from a neglected aspect of the enclosure movements. Peake himself noted the conspicuous distribution of the earliest enclosures and their correspondence with well-marked geological features. He points out their coincidence with the Tertiary beds of the London and Hampshire basins and with the clays of the Weald. Slater has mapped the distribution of the parliamentary enclosures of the eighteenth century, and I have called attention to the fact that their distribution is in very marked accord with that of the Mesozoic rocks of England, particularly with that of the chalk.[21] This gives great strength to the conclusions that there is a close connection between the evolution of a form of settlement and the geological foundation upon which it rests and that the grouping of peoples and the fluctuation of populations are regional manifestations.

The mere fact that enclosure occurred in England is of profound geographical significance. Why did it occur? To my mind it occurred because the townships had greatly exceeded their "optimum density of population" and it was the return to the optimum. Things overshot the mark on the return journey, and the return was revolutionary in character. Indeed, indications are not wanting to show that the adjustment to optimum density may be violently revolutionary. The same results followed at a later date in France, where, prior to the Revolution, agrarian conditions were exceedingly wretched. The peasant was revolving in a circle in which underproduction was causing poverty, and poverty was causing further underproduction.[22] The present troubles of Russia, which is still shackled with the remains of the uneconomic village-community system, are largely agrarian. The adjustments in England and France were made by a violent change in the method of occupation and tillage of the land.

Decline in soil fertility has been advanced as a primary cause of enclosure in England. Peake accepts it as a contributing cause, and Miss Bradley has collected a great deal of evidence on the matter. Lennard has criticized her work[23] and has concluded that the evidence of the proponents of the theory is faulty and inconsistent. He has collected more data which can be reliably tested and states that "it is quite unscientific to conclude that the

[21] Gilbert Slater: The Inclosure of Common Fields Considered Geographically, *Geogr. Journ.*, Vol. 29, 1907, pp. 35–55.

M. Aurousseau: The Arrangement of Rural Populations, *Geogr. Rev.*, Vol. 10, 1920, pp. 223–240; reference on pp. 231–232.

Harold Peake, *op. cit.*, footnote 18, pp. 176–177.

[22] Sydney Herbert: The Fall of Feudalism in France, New York, 1921.

[23] Harold Peake, *op. cit.*, footnote 18, p. 155.

Harriett Bradley: The Enclosures in England: An Economic Reconstruction (Columbia Univ. Studies in Hist., Econ., and Public Law, Vol. 80, No. 2), New York, 1918.

Reginald Lennard: The Alleged Exhaustion of the Soil in Medieval England, *Econ. Journ.*, Vol. 32, 1922, pp. 12–27.

open field farms did decline in fertility in the fourteenth and fifteenth centuries." In support of the statement, he cites the evidence of the Rothampstead experiments in continuous cropping, which show that a minimum return is reached in a few decades and can be maintained almost indefinitely. But is not this very result a consequence of decline in soil fertility? Certainly Russia, no matter how unsatisfactory and uneconomic her agriculture, shows no clear indication of a decrease in soil fertility through centuries of cultivation by antiquated methods. Indeed, we find Durand stating clearly that density of population is the principal evil in eastern Europe, the main trouble with agriculture being due to inadequate plowing, unsatisfactory rotation, and the ownership of scattered, miniature patches and strips of land, no redistribution having taken place since the seizure of the large estates. The open fields still persist but in full peasant ownership.[24]

The explanation appears to lie rather in what Peake implies in several passages: First, population increased in the townships faster than new lands were brought under cultivation; then it increased after no more lands could be brought under cultivation, as a certain proportion of the waste was essential in the economy of the community. The only solution was a complete change in the method of occupation. This was effected ultimately by enclosure.

Little appears to be known of the population of England in the eighteenth century. There was a contemporary controversy during the seventeenth century as to whether it was declining or increasing, and a general belief had been in existence since Tudor times that London was draining the provinces. London certainly increased greatly, in a large measure on account of improved sanitation. It can hardly be doubted that the country as a whole showed a marked increase of population.[25] It is unnecessary to comment on the expansion of the nineteenth century; but the rural decline of that time is of great interest here, having been markedly regional in character.[26] Roxby has investigated five registration districts and finds that the fluctuations of population during the century take their character according to well-marked geographical regions. Certain favored regions of lower status, like the Vale of Evesham and the Vale of Wisbeach (Cambridgeshire), showed a continuous and steady *increase*. The movement towards small holdings and subdivision has also been regional in character.

## The Regional Limitation

It has been suggested above that there is a limit of capacity for occupation of the land of a region. This limit is more clearly shown by an examination

[24] E. D. Durand: Agriculture in Eastern Europe, *Quart. Journ. of Economics*, Vol. 36, 1922, pp. 169–196. Abstracted in the *Geogr. Rev.*, Vol. 12, 1922, pp. 489–490.

[25] M. Dorothy George: Some Causes of the Increase of Population in the Eighteenth Century as Illustrated by London, *Econ. Journ.*, Vol. 32, 1922, pp. 325–352.

[26] P. M. Roxby: Rural Depopulation in England during the Nineteenth Century, *The Nineteenth Century and After*, Vol. 71, 1912, pp. 174–190.

of the rural arrangements than by any other means, the possibility of the extent of growth of the higher elements being practically unknown. That numerous towns have remained practically stationary in their population for long periods is certain; but the relation of town growth to the productivity of the region in these days of intense production and interdependence of regions, has not been studied.

The limit of occupation is the limit of subdivision, so far as rural folk are concerned. The economists of Europe, who demand great increase of population as a first necessity for further progress, are apt to overlook the fact that Europe has been producing people for a very long time under methods of occupation which have been relatively stable. The limit of subdivision has been reached in some regions, and the only possible growth is the growth of the cities and conurbations through the expansion of industry. France appears to be in this condition. It means that France must become increasingly dependent on external regions for the support of her people, and it is questionable whether external regions will long continue to supply the outside world to the same extent as they do at present. They themselves are growing. On the rich alluvia, as in China, space economy is already operating. In India and Egypt the God of Waterwheels is still extending the arable limits, with the assistance of modern irrigation engineering; but on the Flemish lowlands it is hard to imagine any extension of the present occupation.

The evolution of Norse settlement in the Shetland and Orkney Islands illustrates the results of the system of subdivision very well. Norse society lived under its own laws and customs in these islands until the middle of the sixteenth century. In 1468 the islands passed on mortgage to the Scottish Crown—a tenure which remains to the present day. Passing north from the shores of Scapa Flow on the Mainland of Orkney, one sees arable patches of 200 to 400 acres in extent. These are the "townships" and mark the position and extent of the original Norse estates. The traditional inheritance was one of impartial subdivision, and the present-day result is an occupation of the township by four to twelve or more small farms. In aspect the old estate is now a group of small and irregular fields, sprinkled fairly evenly with clusters of low buildings. Every member of the family had rights in his ancestral property, and subdivision was carried on until it was no longer practicable.[27] This result is becoming evident on the Continent, and in those parts of England, like the Vales of Evesham and Wisbeach and the lowlands of Essex, where the method of occupation is taking on the character of that of the Low Countries. In eastern Europe, according to the statement of Durand given above, we find density of population to be a condition of aggravation. Without the temporary palliative of emigration it is hard to conceive what the present-day state of industrial Europe would have been. In pastoral England an increase of the agrarian effort is still possible, and considerable extension did take place in agriculture during the war.

[27] J. S. Clouston: A Branch of the Family, *Blackwood's Mag.*, Vol. 207, 1920, pp. 516–528.

## The Sources of Information

Geography has a great amount of delving to do in the history of the occupation of countries. As first assistants we may consult the archeologists, who are able to trace the origins of settlement.[28] For the earlier phases of occupation they are also the only available informants. Written history then takes up the thread and needs to be sifted carefully for every shred of quantitative information and reliable estimate it can give. If I read in the memoirs of Casanova that Ancona had a population of seven thousand in the early eighteenth century, a reliable recorder is giving me geographical information. Statements bearing on the climates of historic times are also likely to prove very useful. For the later periods of history the economists are able to point to valuable results. There is also a legal side to the matter, as old legal usages have exercised a considerable influence in the rate of breaking away from obsolete methods of occupying the land; and legal and church history will not be barren ground. The task of geography itself is to provide accurate regional information. Ultimately we may hope for fairly complete records for a few favored regions, which will be an index to the interactions of the group and its region.

Deductions may also be made from the behavior of primitive peoples of the present day, and anthropology and ethnology are likely to have the information ready at hand. In studying the development of towns the help even of psychology cannot be ignored, in order to understand the reasons for the inertia which, when obviously sensible and beneficial changes are desired, fails to bring them about.

## The Collaborative Attack

The geographical task I have outlined is a formidable one. It is no reflection on geography that there is so great a deficiency of knowledge in these matters but is rather a reflection of the stage of evolution of the science. It is noteworthy that nearly all the references quoted here are of comparatively recent date, while some of them are from out-of-the-way and unlikely sources. Successful attack on the task can be ensured only through the training of qualified men, of geographers of many shades, capable of meeting specialists in other branches of science on their own ground; by effective liaison with other lines of investigation; by the publication of geographical results intended to reach, say, the anthropologist, in an appropriate journal which he is sure to read. Reliable information must also be spread broadcast so that it will come into the hands of the people who will use it. For example, could not the Association of American Geographers, or some kindred body, compile a bibliography of the geography of population and place it in

[28] Such works as William Page: The Origins and Forms of Hertfordshire Towns and Villages, *Archaeologia*, Vol. 69, 1917–18, pp. 47–60. London.

the hands of every town-planning organization in the world and so bring much of it into direct use?

## Modern Tendencies

The modern city, engaged in varied and intensive production, exists because the place where it is located enables it to do what it is doing. It may import its raw material from the ends of the earth, whither it undoubtedly sends its finished products; but it is an expression, fundamentally, of a favored place. Capacity to do one thing enables it to do another, perhaps having little connection with the first or with the place. Take away certain regional endowments, however, and the city would vanish. Very often these endowments take the simple form of easy fuel and easy water supply, with easy ore in the second rank. The great modern city can seldom feed itself on its own region, and the surplus of food production which keeps it going is taking the modified form of uniform regional production for export. The great producing plains, especially, have ceased to indulge in the numerous minor activities of agriculture. They have handed over these duties to the towns and are doing things on the largest possible scale, often with a surprisingly small number of men. The world as a whole is reacting as a region. The major regions are showing a tendency to develop uniformity of production in the service of all who need, taking their own varied necessities in their turn from many other regions. We speak now of an overpopulated Europe. Somewhere, far ahead, is the prospect of an overpopulated world. Will the adjustment that small regions have had to make in the past be the index of revolutionary changes in the method of occupation of Europe and ultimately of the world?

## Some Provisional Conclusions

Present-day geography is not in a position to make a useful and quantitative contribution to the population question. In this consideration of the matter endeavor has been made to state the case and to suggest the line of its investigation. The following provisional conclusions are advanced as a qualitative effort in the development of a working hypothesis.

1. The geographic problem is the provision of information concerning the occupation of the regions of the globe for immensely larger populations of the future.
2. The occupants of the geographic region are the major units of the world's population. They constitute the group, which is a functional section of society.
3. The group consists of recognizable elements which exist in the service of production and are to be distinguished according to their grade of production.
4. The elements of the group occupy the region in a characteristic manner, dependent upon its configuration, climate, geological nature, etc. Free, natural arrangement is an evolutionary result.

5. Consideration of arrangement suggests that the region has a limited capacity for occupation under a given method.
6. In past times groups have exceeded the limit of occupation and have adjusted themselves by revolutionary change of the method of occupation.
7. Overpopulation is the condition arising from the occupation of a region by a method no longer suitable to support the group.
8. The present trend indicates that the world as a whole is reacting towards population as one region.

# ECONOMIC GEOGRAPHY OF THE COAL RESOURCES OF ASIATIC RUSSIA

By P. P. GOUDKOFF

[With separate map, Pl. V, facing p. 292]

The building of the Trans-Siberian railway wrought a transformation in the economic life of northern Asia. Population flowed in; agricultural development advanced on a large scale; Siberia began to export the products of forest and field. A wholly new era dawned in the mining industry: improved methods of extracting ores were put into practice, and the output of many mineral products leaped to figures hitherto undreamed of.

The World War, instead of retarding, served as a further stimulus to this progress. Indeed, at the outbreak of the Revolution Siberia and Turkestan seemed to be on the eve of a great epoch of prosperity. In 1917 the normal increase of population was being mightily augmented by a stream of refugees from Russia's western provinces. Work was well started on the construction of new railways. Notable movements were either under way or projected in the two foremost industries of Asiatic Russia, agriculture and mining.

## AGRICULTURAL DEVELOPMENT

In the field of agriculture investigations were being made with a view toward introducing the cultivation of the sugar beet into the province of Semipalatinsk and into the southern parts of the governments of Tomsk and Yenisei. Hitherto the principal beet sugar territory of the Russian Empire had been those western governments which were being overrun by the Germans and whence came refugees accustomed to the raising of this crop. Recently completed irrigation systems in Turkestan were expected to bring water to new cotton fields. The southern part of the Tobolsk government and the districts adjoining the railway between Omsk and Tomsk as well as along the Altai railway constituted a rapidly growing wheat country and gave promise of a brilliant future for the flour mills of this part of Siberia—mills which, under stable conditions, should count among the largest consumers of Siberian coal. Farther east, in the Amur province, new land was being opened up to crops; in the Maritime province successful attempts at rice cultivation had been made, and a further increase in flax sowing was looked for.

## MINING AND METALLURGY

In the field of mining and metallurgy, the construction of a large iron foundry in the southern part of the Tomsk government was begun, and the improvement of older works in the Minusinsk district and in the Irkutsk

government and Transbaikalian province was projected. The opening of new silver, lead, zinc, and copper mines in the Kirgiz Steppes, West Altai, and Minusinsk regions seemed probable. Well on the way toward realization were plans for the re-establishment of the exploitation of numerous and rich silver-lead deposits in Transbaikalia and for the reconstruction of the ore-dressing mill connected with the Tetiukhe mine on the Pacific coast about 200 miles north of Vladivostok, the largest lead-zinc mine in all Russia. Both in the West Altai and in the mountains between the Tom and the upper course of the Yenisei, where quartz mining for gold had been carried on for over twenty years, the possibilities of further developments were far from exhausted. First steps toward the introduction of quartz mining into the northern part of the Yenisei government had been made only a few years before; and in the Far East, where gold was still being obtained almost exclusively through placer mining, lode-gold deposits unquestionably of no slight importance remained unexplored. Mechanical methods of placer mining were being proved a signal success in the Yenisei government, but their successful application had also been demonstrated in many parts of eastern Siberia. Furthermore, in this far eastern portion of Asiatic Russia, which has continuously yielded more than 75 per cent of the total output of Russian gold, some new and rich gold fields had been recently discovered.

Besides these industries, we should not neglect to mention the coming commercial utilization of the oil fields of Transcaspia, Turkestan, and Sakhalin; of the salt deposits and salt lakes and springs in Transcaspia and in the governments of Tomsk, Yenisei, Irkutsk and Transbaikalia province, and perhaps in the Yakutsk province; and finally of the so-called rare metal ores of Turkestan, Transbaikalia, and elsewhere.

## The Demand for Coal

All of these contemplated industrial developments foreshadowed a rapidly augmenting demand for coal—a demand destined to become even more pressing with the completion and operation of over 4700 miles of projected railway lines, with the inevitable substitution on the river steamers of the use of coal for that of wood, and with the increase in the number and size of the Ural iron works which were becoming more and more dependent on Siberian coke. The coal deposits of Siberia, however, were more than capable of meeting these probable demands. Indeed, it was planned that by the year 1930 the annual output of the coal mines of western Siberia alone should be increased to ten and a half million tons as contrasted with one and a half million tons of 1917.

But even this latter figure, small as it may seem when compared with the estimated future output, is immense when compared with the annual output of the latter years of the last century (as low as thirty to forty thousand tons) and gives a criterion for estimating what had already been

accomplished toward the industrial utilization of Siberian resources during the twenty years before the Revolution. Prior to 1900 the population of Siberia was sparse (less than eight and a half million in 1897), and there was almost no demand for Siberian coal either in Siberia itself or in European Russia. What need there was for fuel in Russia's great Asiatic domain was met by immense and widely distributed forests. After 1897 the Trans-Siberian railway itself created the first genuine demand for coal, a demand soon to be followed by the requirements of the industrial expansion that followed in the train of the railway.

With a demand for coal came the exploration of the resources available. Geologists and operators began to see clearly what they had little suspected before: that the coal reserves of Asiatic Russia were very considerable in amount and high in quality. A summary of data on Russian coal was made by the Russian Geological Committee for the Twelfth International Geological Congress at Toronto in 1913 and was published in Volume 3 of "The Coal Resources of the World."[1] More recent information has since then been acquired, and the summary referred to is now entirely out of date as a result of systematic explorations inaugurated by the Geological Committee in 1912 and of explorations carried out by mining companies. The former, in co-operation with a Commission of the Russian Academy of Sciences for the Investigation of the Natural Resources of Russia, produced a report in 1919[2] which differs widely from that made to the Toronto Congress. Since 1919, as exploration has gone forward, additional reports have been published by the Siberian[3] and Far Eastern Geological Committees;[4] and several significant papers on the Siberian coal industry have appeared in newly established Russian periodicals,[5] all of which throw fresh light not only on the coal resources but also on the geology and geography of Asiatic Russia as a whole.

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[1] The Coal Resources of the World: An Inquiry Made Upon the Initiative of the Executive Committee of the XII International Geological Congress, Canada, 1913, 3 vols., Toronto, 1913.

[2] The Natural Resources of Russia (Yestestvenniya Proizvoditelniya Sili Rossii), Vol. 4, No. 20, "Coal" (Publications of the Commission for the Investigation of the Natural Resources of Russia Associated with the Russian Academy of Sciences), Petrograd, 1919.

[3] Notably the following articles in *Bulletin of the Siberian Section of the Russian Geological Committee* (*Izvestiya Sibirskago Otdeleniya Geologicheskago Komiteta*) published in Tomsk: (1) N. N. Urvantsev: The Norilsk Coal-Bearing Basin, with 18 drawings and a geological map, Vol. 2, No. 1, 1921; (2) K. E. Gabuniya: The Kasyanovo-Grishevsk Coal Deposit of the Cheremkhovo Coal-Bearing Region, with 17 drawings, Vol. 2, No. 3, 1921; (3) M. K. Korovin: The Cheremkhovo Coal-Bearing Basin, with 11 plates of drawings and maps, Vol. 2, No. 4, 1922.

[4] E. E. Ahnert: What Has Been Done and What Remains To Be Done for the Geological Study of the Russian Far East and Its Mineral Resources, *Records of the Geological Committee of the Russian Far East* (*Materiali po Geologii i Poleznim Iskopaemim Dalnyago Vostoka*), No. 1, Vladivostok, 1920. See also "The Mining Industry and Mineral Resources of the Russian Far East" (Gornaya Promishlennost Russkago Dalnyago Vostoka), a report compiled by P. P. Goudkoff and P. I. Polevoi at the request of the Maritime Chamber of Commerce, Vladivostok, with a map of the mineral deposits of the Russian Far East, Vladivostok, 1921.

[5] B. I. Shlain: The Coal Industry of West Siberia, *Mining* (*Gornoe Delo*), Moscow, 1920; S. V. Obruchev: The Coals and Graphites of the Turukhansk Region, *Mining Journal* (*Gorni Jurnal*), Nos. 3–5, 6–9, Moscow, 1922; I. I. Fedorovich: Prospects in the Coal Industry of West Siberia, *ibid.*, Nos. 3–5, Moscow, 1922; V. A. Obruchev: The Natural Resources of Russia and their Utilization, *Bull. Moscow Mining Academy* (*Vestniki Moskowskoi Gornoi Akademii*), Vol. 1, No. 1, 1922, pp. 3–13. See also A. Gapéev: On the Question of the Ekibastuz and Priirtish Coal Deposits, *Materials of General and Applied Geology* (*Materiali po Obshchei i Prikladnoi Geologii*), No. 44, Petrograd, 1920 (with two plates).

In view of the immensely important part which the coal deposits will play in the economic regeneration of Russia which is bound to come and which we may assume will follow, in a general way at least, the channels already marked out at the outbreak of the Revolution, it seems worth while to discuss briefly each of the individual coal basins and to indicate something of their economic and geographic relationships. We may divide these basins into two main groups. In the first are those which are best known and situated most advantageously in respect to present centers of population and lines of communication. In the second category are the deposits which have been less thoroughly explored, are less favorably situated geographically, and whose probable future importance we may only estimate in a very general way. To the first group belong the basins of Kuznetsk, Irkutsk, Minusinsk, the Kirgiz Steppes, Sakhalin Island, and the Maritime province, as well as the less rich deposits of Turkestan and the brown coals of the Yenisei government. In the second group fall the coal fields of the Amur and Transbaikalian provinces and of the Tungusk basin and the deposits of the Yakutsk and Kamchatka provinces.

On the accompanying map (Pl. V, facing p. 292), the larger basins and fields are shown in black[6]; separate deposits of lesser area and known crops are indicated by crosses.

## Coal Basins and Fields of Primary Importance at the Present Time

### 1. The Kuznetsk Basin and Gorlovo Field

The coal reserves of this basin, which covers over 8600 square miles, are said to represent more than 50 per cent of the total reserves of Russia. Only within the last decade has their full significance been appreciated. The coals are of all kinds and of high quality. Mining was first developed in the northern part of the area in 1898, when the western section of the Trans-Siberian railway was opened. The demand for fuel by the railway led to a rapidly mounting output from the mines, which in the years between 1910 and 1917 increased over tenfold, or from 88,710 to 1,237,800 metric tons annually. It is estimated that in the near future the annual output, in so far as it depends on the reserves of coal prepared for mining, may well reach ten million tons. This would not only satisfy the demand for fuel in western Siberia expected to prevail in 1930 as a result of the increase of population, the construction of many miles of railways now contemplated, the transition on the river steamboats of the Tom, Ob, and Irtysh from wood to coal burning, and the development of the local metallurgical industries, but it would also make possible the realization of a project for

[6] The coal deposits as shown on this map are based upon: (1) a map annexed to "The Natural Resources of Russia," Vol. 4, No. 10, "Gold" (see above, footnote 2); (2) a map in "The Mining Industry and Mineral Resources of the Russian Far East" (see above, footnote 4); (3) S. V. Obruchev: The Tungusk Basin, *Ore Bulletin* (*Rudni Vestnik*), Moscow, 1918, No. 4. The density of population is adapted from "Atlas of Asiatic Russia" (Atlas Aziatskoi Rossii), edited by the Department of Immigration, Ministry of Territorial Organization and Agriculture, St. Petersburg, 1914, map No. 26.

the construction of three large iron works in the Ural to be operated with Kuznetsk coke. In this connection, the total quantity of fuel which will have to be transported to western Siberia and the Ural region will probably amount to as much as 13 million tons, about 75 per cent of which must be furnished by the Kuznetsk basin.

Between 1913 and 1917 geological explorations and prospecting were conducted throughout the basin by the Kuznetsk Coal Mining Company. The construction of a railway, which is to run through the basin from north to south, was completed in 1919 to a point about 52 miles northwest of the town of Kuznetsk.

West of the Kuznetsk basin lies the so-called Gorlovo anthracite field, occupying an area some 43 miles long by 6 miles wide. The reserves of the northern part alone are calculated at 3.8 million tons, but, owing to unfavorable geological conditions, this field is as yet undeveloped.

### 2. The Irkutsk Basin

This basin occupies an area of 17,200 square miles, or nearly twice that of the Kuznetsk fields. Over 32 million tons have already been prepared for mining by means of excavators. For the most part the deposits consist of bituminous coking coals; but at some places a transition into brown coal is known to occur, and resinous coals are found in other localities.

Here it was that coal mining on a large scale was first conducted in Siberia. The Irkutsk basin has supplied fuel for the Transbaikalian and Amur railways, and coal has been shipped from it westward as far as Taiga (southeast of Tomsk) and occasionally even to the Ural mountains. The output has ranged as high as fifty per cent of that of all the Siberian coal mines (1,237,800 tons in 1917). Future development is guaranteed by geological conditions exceptionally favorable to mining, by an advantageous position along the railway for a distance of over 300 miles, and by the absence of sufficiently developed mines in the Transbaikalian and Amur provinces. If the production of coke is found possible, the future of the region will be even brighter. Furthermore, in connection with the projected enlargement of the Ural metallurgical industry referred to above, it has been estimated that by 1930 no less than 2.42 million tons of Irkutsk coal may be transported annually in a westward direction.

### 3. The Minusinsk Basin

The coal-bearing formations near Minusinsk cover an area of 215 square miles and include both bituminous coking coals and sub-bituminous coal, of a quality on the whole somewhat inferior to that of the Kuznetsk coals though superior to that of the Irkutsk fields. The total output before the revolution was very limited in comparison with the output of the Kuznetsk basin, being 21,000 tons in 1914 and 40,000 in 1917. Future development depends upon the improvement of means of communication. The Achinsk-

Minusinsk railway, which will connect the coal fields with the Trans-Siberian line, is as yet unfinished, for, although the roadbed, stations, and many of the bridges have been constructed, rails have been laid only to a point some 30 miles south of Achinsk. The line Minusinsk-Kuznetsk-Barnaul, which will also link up the basin with the Trans-Siberian and South Siberian roads, is as yet merely a project. Much may be expected from the completion of these routes, as well as from the increase of steam navigation on the Yenisei and from the exploitation of the rich iron and copper ore deposits of the southern part of the Minusinsk district. Broadly speaking, it is expected that 350,000 tons of Minusinsk coal will be sent annually to western Siberia for use as fuel.

### 4. The Kirgiz Steppes

The deposits of the Kirgiz Steppes consist of anthracites, coking coals, dry coals, and brown coals—all of relatively inferior quality. The total output mounted from 27,666 tons in 1914 to 98,050 in 1917. Slow advance in the industry has been largely the result of inadequate means of communication. The portion of the South Siberian railway west of Semipalatinsk was not begun until 1917. Though the deposits are neither large nor of high quality, they are of great local value on account of the absence of any other fuel in the region. Lack of adequate communications has also been a serious handicap to the exploitation of the numerous copper, silver-lead, and zinc deposits of the Steppes, as well as to the progress of steam navigation on the Irtysh.

### 5. Sakhalin Island

The Sakhalin fields are the best of all deposits immediately adjacent to the Pacific. They include an abundance of high-quality bituminous and coking coals and more or less lignite. Development has been seriously retarded by the absence of good harbors for the protection of loading vessels from the stormy waters of the Gulf of Tartary.

### 6. The Maritime Province

Coal-bearing Jurassic rocks and lignite-bearing Tertiary deposits are widely distributed in the southern part of this province north and south of Vladivostok and for a long distance along the coast. The Jurassic coals are mainly anthracites and semi-anthracites, but coking coals and some other kinds also exist. Most of the coal is of rather low quality, though the lignites furnish a good fuel and in some deposits are very rich in volatile matter. The total production (including lignite) in 1917 was 584,800 tons. Inasmuch as a very considerable part of the coal-producing area is still unexplored, the real reserves may be greater than the estimated figures. A large increase in mining in this region is to be expected coincidently with the growth of sea and river fleets, the construction of railways, and the

probable future development of the metallurgical industries on a more extensive scale.

The brown coals of the Maritime province are rich in volatile matter: it is thought likely that they will be utilized for obtaining distillation products such as paraffin, benzine, creosote, etc.

### 7. The Brown Coal Fields of Yenisei Government

Several basins of rather large size constitute these fields. Some of the seams are rich in volatile matter which renders possible their use in the production of paraffin and other similar substances. Good domestic fuel can also be obtained from them. In the years 1917–1918 only a few small mines were in operation in this district.

### 8. Turkestan

The fields of Turkestan contain anthracite, coking, and non-coking coals, but of these only the coking and non-coking coals are of practical importance. On account of their low calorific power and the unfavorable conditions of stratification in which they occur, the latter have come into use only after the almost complete exhaustion of wood for fuel.

## Coal Basins and Fields of Secondary Importance at the Present Time

### 9. The Amur Province

Four fields of bituminous coal and one rather large basin of brown coal (about 215 square miles) are known in the Amur province. Shortage of fuel needed for the Amur railway and the impending change from the use of wood to that of coal on the large fleet of steamers on the Amur River will in all probability stimulate their development. A contributary incentive may well be provided by the exploitation of the very promising iron-ore deposits in the vicinity of the Little Khingan range. Means of communication, however, must first be improved.

### 10. Transbaikalian Province

The coals of the Transbaikalian province are found in separate and very small basins which contain beds of brown coal. Mining has been carried on only in two fields and there on a small scale. The most promising fields are those which lie near the town of Chita, where mining by excavators is possible, and the Bukachachi field, which, alone in the entire region, produces coal of high calorific power. On the whole it is to be expected that the coal industry of Transbaikalia will remain of limited and exclusively local importance.

### 11. The Tungusk Basin

According to S. V. Obruchev, the numerous coal deposits that have long been known in the region between the Yenisei and the Lena must be

considered as belonging to one immense continuous basin occupying an area of as much as 387,000 square miles. The boundaries of this basin, as shown on the accompanying map, are drawn from Obruchev's data. The coals are both anthracite and bituminous, the latter in some localities grading into lignite. Near numerous trap intrusions the coals have been transformed into graphites which form at some places deposits of very considerable extent and of high quality. Information at hand regarding this great basin is very scanty; in fact it is impossible at the present time even to estimate the reserves of the greater part.

### 12. Yakutsk Province

Coal beds are known to exist at numerous points along the Lena north of Bestia station (60 miles below Yakutsk) and at various places in the valleys of the Vilyui, Olekma, Aldan, Indigirka, and Kolima River systems. The beds of the Vilyui valley are perhaps a continuation of those of the Tungusk basin. The deposits of first potential value are probably those on the right bank of the Lena sixty miles above the mouth of the Vilyui near Jigansk.

### 13. Kamchatka Province

Although coal is found at many places in the extreme northeast of Siberia and formations in which it occurs are widely distributed throughout vast tracts, the deposits of this remote quarter still remain almost totally unexplored. It is quite impossible to estimate their reserves even approximately, though it seems likely that bituminous coal and lignite are present in no inconsiderable quantities. The economic importance of these fields will depend on the use that may be made of them as a supply of fuel for the merchant marine and on the exploitation of gold placers known to exist along the coast of the Okhotsk Sea and in the Chukotsk Peninsula.

### Total Resources of the Siberian Fields

Table I is a summary of the total coal resources of the various fields just discussed and of the total reserves of Siberia. "Actual reserves" are calculated on the basis of positive knowledge regarding the actual thickness and extent of the beds; in the case of "probable reserves" only an approximate estimate can be arrived at; and "possible reserves" are those where no estimate in figures can be given. No account of the category "possible reserves" was taken in adding up the grand total. The figure, consequently, is conservative.

According to "The Coal Resources of the World" referred to above, the total coal reserves of the globe were estimated as follows, in million tons:

| | | | |
|---|---|---|---|
| Oceania | 170,410 | North America | 5,073,431 |
| Asia | 1,279,586 | South America | 32,097 |
| Africa | 57,839 | Europe | 784,190 |

Of these total reserves of 7,397,553 million tons those of Siberia were given as 173,879 million tons, which is considerably less than half the figure which can now be given. The resources of Asiatic Russia (over 400,000 million tons) consequently represent a quarter of the total reserves of Asia and are one and a half times greater than those of Oceania, South America, and Africa put together. Nor is it at all unlikely that future explorations in the Tungusk basin, Maritime province and the far northeast may bring to light resources whose amount is unsuspected at the present day.

## Future Development

The Revolution called a halt to the industrial operations which created a demand for these coals. Siberia and Russia during the last five years have together gone through a period of economic setback. Recovery will come through the return to political and social tranquillity and through the re-establishment and increase of exports. In northern Asia Russia will find her most abundant treasure of raw materials for export. As compared with European Russia these resources are almost virgin. But they are also to a very large extent ready for exploitation, and many are very favorably situated in relation to lines of communication by rail, river, or ocean. Hitherto Russia has neglected her Siberian resources perforce, by reason of the scarcity of population in Siberia and the lack of labor which this scarcity entails. Refugees from the war and famine zones, however, have tended materially to make good this lack; and there is no reason why, when conditions are ripe for the resumption of industrial activity, there should not be available an ample personnel to carry forward this activity on an even broader scale than was the promise of 1917.

The most extensive industrial growth may be looked for in the southern and western portions of Asiatic Russia. As one advances eastward there is a progressive diminution in the magnitude of probable developments until, in the far east, one reaches a region where all projects for a long time to come will be confined to the Pacific coast and to the neighborhood of the larger rivers. The distribution of population in the case of Asiatic Russia is a fair index of economic potentialities, and the accompanying map shows how markedly the density of settlement (1911) falls off to the north and east.

The geographical distribution of the coal resources likewise coincides with the regions of probable maximum industrial progress and increase of population. The construction of the Trans-Siberian railway resulted in the acquisition of knowledge of the coal deposits along its route and in their exploitation at a relatively early period. But the presence of the railway accounts only in part for the fact that the known coal deposits shown on our map appear to be predominant in southern Siberia close to the line. Though coals are found widely throughout Asiatic Russia, it is also likely that future exploration will serve to confirm us in our present belief that the southern and central belts are the areas where most coal will be obtained. But even were this not so, the largest basins known at the

TABLE I—COAL RESOURCES OF ASIATIC RUSSIA—(*In metric tons*)

| | ACTUAL | PROBABLE | TOTAL |
|---|---|---|---|
| 1. Kuznetsk basin and Gorlovo field | 1,125,000,000*b*(*a*) | 248,875,000,000*b*(*a*)<br>3,800,000*a* | 250,000,000,000*b*(*a*)<br>3,800,000*a*<br>250,003,800,000*b*(*a*) |
| 2. Irkutsk basin | 1,040,000,000*b* | 148,960,000,000*b*(*l*) | 150,000,000,000*b*(*l*) |
| 3. Minusinsk basin | 72,500,000*b* | 800,000,000*b* | 872,500,000*b* |
| 4. Kirgiz Steppes | | 1,100,000,000*b* | 1,100,000,000*b* |
| 5. Sakhalin Island | 255,000,000*b* | 1,745,000,000*b*<br>2,000,000*l* | 2,000,000,000*b*<br>2,000,000*l*<br>2,002,000,000*b*(*l*) |
| 6. Maritime province | 4,800,000*a*<br>18,230,000*b*<br>32,000,000*l* | 46,970,000*a*-*b*<br>168,000,000*l* | 70,000,000*a*-*b*<br>200,000,000*l*<br>270,000,000*a*-*b*-*l* |
| 7. Brown coal fields of Yenisei government | | 2,050,000*l* | 2,050,000*l* |
| 8. Turkestan | | 170,000,000*b* | 170,000,000*b* |
| Total reserves in the basins of primary importance | 3,280,730,000*b*(*al*)<br>4,800,000*a*<br>32,000,000*l*<br>3,317,530,000 | 400,926,970,000*b*(*al*)<br>3,800,000*a*<br>172,050,000*l*<br>401,102,820,000 | 404,207,700,000*b*(*al*)<br>8,600,000*a*<br>204,050,000*l*<br>404,420,350,000*b*(*al*) |
| 9. Amur province | 1,380,000*b* | 5,000,000*b*<br>625,000,000*l* | 6,380,000*b*<br>625,000,000*l*<br>631,380,000*l*(*b*) |
| 10. Transbaikalian province | 30,000,000*l* | 170,000,000*l* | 200,000,000*l*-*b* |
| 11. Tungusk basin | 32,030,000*b*(*a*) | 40,500,000*b*(*a*)<br>32,000,000*a* | 72,530,000*b*(*a*)<br>32,000,000*a*<br>104,530,000*b*-*a* |
| 12. Yakutsk province | | 650,000*b* | 650,000*b* |
| 13. Kamchatka province | Very considerable possible reserves of bituminous coals and considerable reserves of lignites | | |
| Total reserves in the basins of secondary importance | 33,410,000*b*(*a*)<br>30,000,000*l*<br>63,410,000 | 46,150,000*b*(*a*)<br>32,000,000*a*<br>795,000,000*l*<br>873,150,000 | 79,560,000*b*(*a*)<br>32,000,000*a*<br>825,000,000*l*<br>936,560,000 -*b*-*a* |
| Grand total in all the basins of Asiatic Russia | | | Over 405,000,000,000 |

*a*, anthracite. *b*, bituminous. *l*, lignite. *b*(*a*), bituminous including a minor part of anthracite. *b*(*l*), bituminous including a minor part of lignite. *b*-*a*, bituminous and anthracite in unknown quantitative relations.

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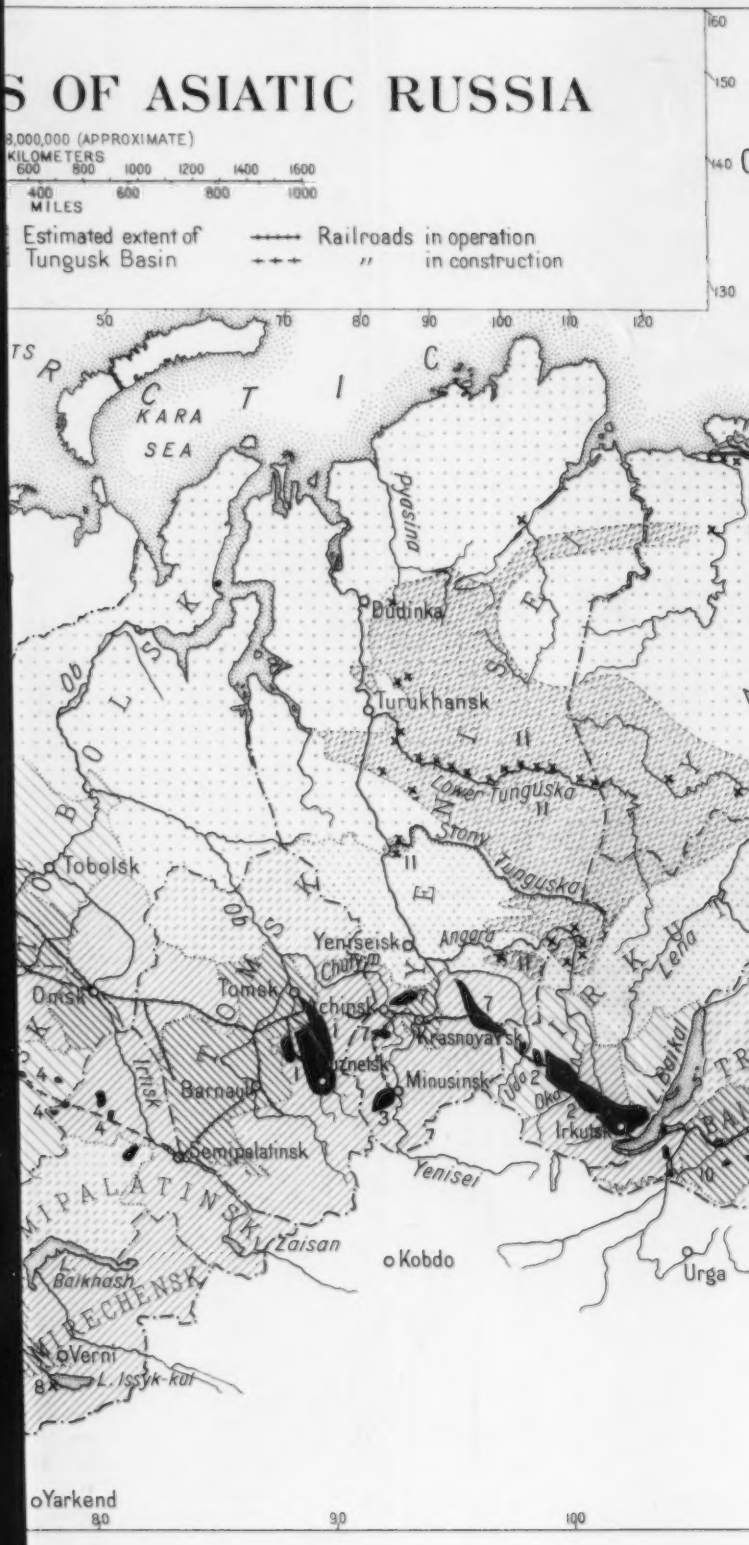
S OF ASIATIC RUSSIA
3,000,000 (APPROXIMATE)
KILOMETERS
600 800 1000 1200 1400 1600
400 600 800 1000
MILES
Estimated extent of Tungusk Basin
Railroads in operation
" in construction
50 70 80 90 100 110 120
160
150
140
130
KARA SEA
Pyasina
Dudinka
Turukhansk
Lower Tunguska
Stony Tunguska
Tobolsk
Yeniseisk
Angara
Lena
Omsk
Tomsk
Krasnoyarsk
Irtish
Barnaul
Minusinsk
Irkutsk
Baikal
Semipalatinsk
Yenisei
Zaisan
Kobdo
Urga
Balkhash
Verni
L. Issyk-kul
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80 90 100

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*The Geographical Review, Vol. XIII, No. 2, 1923, Plate V*

present time, those of Kuznetsk and Irkutsk, are so favorably situated that even without any assistance from other fields the former can satisfy for a long period every possible demand for coal from southwestern Siberia and the latter can do the same in respect to southeastern Siberia. The Sakhalin basin, almost unique among the coal fields of the Pacific coasts by reason of the high quality of its output, seems especially designed by nature for the export trade, and it is probable that the southern Ussuri region (Maritime province) may participate in this export. The successful maintenance of commercial connections with northern Siberia through the Kara Sea seems assured by the discovery of good coal near the source of the Pyasina River and by the probability of equally valuable coal deposits throughout the immense areas of the Tungusk basin which are as yet virtually unexplored. Finally, adding to these circumstances the fact that numerous deposits are known to exist within the province of Yakutsk, we may conclude that industrial development in so far as it depends on coal supplies is possible in any part of Siberia and that, however rapidly the demand for coal in Siberia and even in European Russia may grow, Asiatic Russia will long be in a position to meet this demand.

# AMERICAN GEOGRAPHICAL SOCIETY

**Meetings of January and February.** The annual meeting of the American Geographical Society was held January 23, at the Engineering Societies' Building, 29 West Thirty-ninth Street. After the reading of the annual reports the Society was addressed by the Rev. Hugh Birckhead, D.D., on "Palestine, the Shrine of the Three Great World Religions." At the regular monthly meeting held on February 20 the Charles P. Daly Medal of the Society was presented to Major-General A. W. Greely. After the ceremony Captain Kilroy Harris delivered a lecture entitled "Through Unknown Australia."

**Elections to Fellowship.** At the November, December, January, and February meetings of the Society, President Greenough presiding, there were presented with the approval of the Council the names of 527 candidates who were duly elected as Fellows of the Society.

**Presentation of the Charles P. Daly Medal to Major-General A. W. Greely.** The Charles P. Daly Medal of the American Geographical Society was presented to Major-General A. W. Greely at the February meeting of the Society. In presenting the medal President Greenough spoke as follows:

"It is my pleasing duty tonight as your representative to present your Gold Medal to one of our own countrymen. The inscription attempts to condense in thirty words the results of a long and successful career. It reads as follows:

ADOLPHUS WASHINGTON GREELY
1922
*He commanded an Arctic expedition*
*the results of which are among the*
*imperishable records of polar discovery*
*and he subsequently rendered*
*distinguished public service as Chief of the*
*United States Signal Corps*

"Even with larger space allotted to me it is difficult to summarize suitably the notable attainments of our guest in the diversified fields of soldier, explorer, scientist, and writer; but I may attempt it briefly. In our Civil War his almost unique advance from private soldier to Brigadier-General was the prelude to continuous military employment until retirement by seniority in 1908 as Major-General. The interval gave opportunity for important service in Cuba, Porto Rico, China, and the Philippines, besides memorable humanitarian work as head of the relief service at the San Francisco earthquake. The Arctic Expedition of 1881 under his command reached farthest north at that period (83° 24′) and added new areas of land and sea to the map, reaching home after enduring almost unprecedented hardship and losses. Scientifically, the Lady Franklin Bay Expedition contributed many valuable researches. It made the nearest gravity observations to the pole, ascertained the climatic conditions of Grinnell Land, determined the hitherto unknown secular magnetic variation of that region, made glaciological studies, and through its tidal observations first disclosed the conformity of the sidereal day with the diurnal inequality of the tidal waves of the earth. The geographical discoveries included the interior of Grinnell Land, the shores of the western polar sea, and the extension of Greenland to within fifteen miles of its extreme northern latitude.

"Even a partial recapitulation of his published volumes attests alike the value and variety of his literary work. I may mention a part, namely: 'Proceedings of the Lady Franklin Bay Expedition' (1888), 'Three Years of Arctic Service' (1885), 'American Explorers and Trav-

elers' (1894), 'Handbook of Polar Discoveries' (1896), 'Handbook of Alaska' (1912), 'Isothermal Lines of the United States' (1881), 'Rainfall of Western States and Territories' (1888), 'American Weather' (1888), 'Climatology of Arid Regions' (1891); and there are many others.

"In its recognition of the accomplishments that I have indicated our Society has honored itself and has added a worthy companion to the existing holders of our medal, which include the names of Peary, Amundsen, Stefansson, Younghusband, Penck, Brooks, Chisholm, and others equally distinguished.

"And now, Sir, in behalf of the American Geographical Society I ask your acceptance of this memento of its appreciation and good wishes together with the expression of its pleasure in thus associating its reputation with your own."

In accepting the medal and in replying to the address of presentation, General Greely referred to his first lecture before the Society upon the return of his expedition many years ago and made happy allusion to the pioneering and exploring instinct of the American people. He referred also to the international co-operation which was required to make the simultaneous meteorological records in which his expedition participated. He stated that the greater part of the meteorological records had never been worked up and that when this task was accomplished it would be found to contribute to an important degree to our knowledge of Arctic climate.

**Award of the Cullum Geographical Medal to Edward A. Reeves.** The American Geographical Society announces the award of its Cullum Geographical Medal to Edward A. Reeves, of the Royal Geographical Society, London. The medal bears the inscription:

EDWARD A. REEVES
1922
*In honor of his substantial achievements*
*in geographical surveying.*
*By devising and improving instruments and methods*
*he created new standards*
*in the field of scientific exploration*

Mr. Reeves has been connected with the Royal Geographical Society for over fifty years, the last twenty of which he has been in charge of the Course of Instruction in Practical Astronomy, Surveying, and Map Construction. He has written several books and numerous articles in the sphere of his work, including "Maps and Map-making" (1910) and "Surveying: Past and Present" (1916), and he is editor of the Royal Geographical Society's "Hints to Travellers."

**Award of the Charles P. Daly Medal to Ernest de K. Leffingwell.** A third award of the Charles P. Daly Medal of the Society for 1922 has been made to Ernest de Koven Leffingwell, Arctic explorer and student of Arctic geography. The medal bears the inscription:

ERNEST DE K. LEFFINGWELL
1922
*For producing the first*
*accurate chart of a part of the*
*Arctic coast of Alaska*
*and for sustained and original investigations*
*in Arctic physiography*

During the years 1905–1915 Mr. Leffingwell spent six winters and nine summers in Arctic Alaska. The results of his arduous researches, prosecuted almost entirely unaided, have been published by the United States Geological Survey as *Professional Paper 109*, "The Canning River Region of Northern Alaska."

**Annual Reports of the Society.** At the annual meeting of the American Geographical Society, held on January 23 at the Engineering Societies' Building, 29 West Thirty-ninth Street, the annual reports of the Council, of the Treasurer, and of the Special Committee were read as follows:

REPORT OF THE COUNCIL

*To the Fellows of the Society:* New York, January 23, 1923

The report of the Council for the past year necessarily summarizes activities of wide range in research and in the popular presentation of subjects of geographical interest, following the precedent of past years. It is noteworthy, however, that the list of publications is larger than ever before and the appreciation of the public and of professional geographers quite exceeds its customary expression. Its steady contributions to the permanent body of scientific knowledge, in our judgment, justify the claim that the Society is an agency of very substantial value to the community and to the nation. It aims, on the one hand, to maintain collections of the first order, and, on the other, to use these collections and the energies of its staff in such a way as each year to do pioneer work in the field of geographical investigation.

In continuation of the policy of maintaining the library as an instrument of research on the part of scholars and writers, special attention has been given to the completion of a large number of serial publications, to the purchase of books and maps to fill gaps in our general collections, and to bind unbound books and mount maps so as to bring the collection into first-class physical shape.

Additions to the library during the year comprise 1465 books, 879 pamphlets, 5822 periodicals, 3257 maps, 68 atlases. The collection now numbers 61,675 volumes of books and pamphlets and 57,228 atlases and maps.

In addition to visitors who are interested in exhibitional features, such as our collection of wall maps, etc., there now come to the institution a growing number of consultants of the highest class, persons engaged in serious research requiring a specialized library with collections essentially complete in the various branches of the subject. This number has rapidly increased in the past few years, or since the war, on account of the many changes that have taken place in the maps of the period and a corresponding increase in public interest in applied geography.

The regular monthly lectures have been unusually well attended and appreciated. The speakers have been as follows: Mr. Henry Lee Shuttleworth, I.C.S., Professor Albert Bushnell Hart, Professor A. V. Williams Jackson, Mr. Fred Payne Clatworthy, Honorable John W. Davis, Mr. Carl E. Akeley, Mr. Charles Upson Clark.

The following awards were made of the Gold Medals of the Society: The Charles P. Daly Medal to Lieutenant-Colonel Sir Francis Younghusband, to Major General Adolphus Washington Greely, and to Ernest de Koven Leffingwell, Esq.; the Cullum Geographical Medal to Edward A. Reeves, Esq. The distinguished services in recognition of which these awards were made are detailed in the current number of the *Geographical Review*.

The *Geographical Review* has been continued as a quarterly periodical. Publication in this form permits each number to cover a wide range of interest and makes possible a harmonious balance of contents. Each number contains several well-illustrated articles, many of a descriptive nature and dealing with travel and exploration—a great Chinese river, the little-known territory of eastern Bolivia, the heart of Africa, an island of Arctic Russia. Such articles not only make interesting reading but are important sources of information. Many are noticed in domestic and foreign publications. The article on Belgium's mandatory territory has, for instance, been abstracted at length in French and Belgian colonial publications. Other articles of wide appeal are offered as contributions towards the solution of such contemporary problems as that of population or political developments in various parts of the world. More technical articles, many of which deal with the physical bases of geography, are primarily intended for professional workers. Similar variety is maintained in the sections devoted to record and reviews.

In addition to certain books and maps, the titles of which are given in the list of publications for 1922, the Society has steadily advanced its program of work upon the geography of Hispanic America. There are now in hand in various stages of preparation twenty-one sheets of the Millionth Map of Hispanic America in addition to the La Paz sheet already published, and it is hoped to carry this great work through to completion in the course of the next seven years, or possibly a shorter period if additional funds are to be obtained. As a necessary part of the program there has been gathered together a great catalogue of about ten thousand titles of maps published in books and sheets. It is hoped to complete this work and to reproduce it in typewritten form in a limited number of copies so as to make it available in a half dozen centers of research. Wide interest has been displayed in the great atlas that the one hundred sheets of Hispanic America will constitute, and especially over the light that these maps and the information upon which they were based will shed on many questions of distribution and relationship not only in geography but in a number of cognate sciences. The Society has sought to interest its Councilors and members in a plan of subscription to the cost of this work whereby, through the payment of a thousand dollars, an individual may become the patron of a given sheet, which will then bear his name or the name of some institution or corporation whom he may designate.

The very considerable expense of the Hispanic American Research and of the Monograph Publications has been defrayed by donations from members of the Council, who, however, deprecate any further acknowledgment of their generous support.

The year has been marked by the publication of an exceptionally large number of books and maps of permanent value, covering a wide range of geographical interest. The following list supplies the main title of each publication and a brief characterization of it:

1. BERING'S VOYAGES: An Account of the Efforts of the Russians to Determine the Relation of Asia and America. By F. A. Golder. Vol. 1: The Log Books and Official Reports of the First and Second Expeditions, 1725–1730 and 1733–1742. With a chart of the second voyage. Vol. 2: G. W. Steller's Journal of His Sea Voyage from Kamchatka to America on the Second Expedition.

(It was through the work of Bering's expeditions that the true position of a part of northwestern North America was first known.)

2. THE FACE OF THE EARTH AS SEEN FROM THE AIR: A Study in the Application of Airplane Photography to Geography. By Willis T. Lee.

(Illustrated by 80 oblique and vertical photographs.)

3. THE RECESSION OF THE LAST ICE SHEET IN NEW ENGLAND. By Ernst Antevs.

(The rate of retreat of the ice sheet from Hartford, Conn., to St. Johnsbury, Vt., as determined by a study of certain fresh-water clays.)

4. GEOGRAPHY OF THE CENTRAL ANDES. By Alan G. Ogilvie.

(A regional geography of a part of the Andean realm to accompany the La Paz sheet of the Millionth Map of Hispanic America. Illustrated with 17 photographs and 2 colored maps.)

5. LEGENDARY ISLANDS OF THE ATLANTIC: A Study in Medieval Geography. By William H. Babcock.

(A classic treatment of the age-old problem of Atlantis as well as other islands celebrated in legend.)

6. A SHORT ACCOUNT OF THE FIRST SETTLEMENT OF THE PROVINCES OF VIRGINIA, MARYLAND, NEW-YORK, NEW-JERSEY, AND PENNSYLVANIA, BY THE ENGLISH.

(Reprint of a rare booklet of special value in a study of colonial boundaries.)

7. INDEX TO THE JOURNAL OF GEOGRAPHY, 1897–1921, including the Journal of School Geography, 1897–1901, and the Bulletin of the American Bureau of Geography, 1900–1901. By Arthur A. Brooks.

(An instrument of study comparable to the Index to the former Bulletin of the Society published in 1918.)

8. List of Maps of Hispanic America. I. Maps Contained in Periodical Publications.

(Limited edition of typewritten copies bound in book form and to be followed by several volumes dealing with maps in books and sheets.)

9. A Catalogue of Geological Maps of South America. By Henry B. Sullivan.

(A convenient index for physiographic study.)

10. Map of Hispanic America, 1:1,000,000 (15.78 miles to 1 inch), Sheet South E–19. La Paz, Provisional Edition.

(Conforms to the international standard of the Millionth Map. In 22 color tints.)

11. Map of Hispanic America, 1:6,000,000 (about 100 miles to 1 inch).

(Published in three sheets as a base map for representing geographical distributions.)

12. Distribution of Population in the La Paz Sheet Area, 1:2,000,000.

(Accompanies "Geography of the Central Andes." Shows population in nine grades of density.)

13. Map of the La Paz Sheet Area to Show Utilization of the Land, 1:2,000,000.

(Accompanies "Geography of the Central Andes." It shows types of agriculture, including plantation cultivation, and the centers of chief mineral production of 1915, together with the location of the most important mines.)

14. Map of Alaska. Published jointly with the Alaska Road Commission, War Department, scale 1:1,250,000, or about 20 miles to one inch.

(Bears five thousand place names; shows roads of every type, radio, telegraph and cable lines, post offices, national parks and forests, and the population of towns according to the census of 1920.)

15. Map Illustrating the Recession of the Last Ice Sheet from New England and New York. By J. W. Goldthwait. Scale, 1:1,250,000.

(Accompanies Antevs' "The Recession of the Last Ice Sheet in New England." The successive positions of the ice border are shown in red overprint.)

16. Chart of the Voyage of Bering and Chirikov in the "St. Peter" and the "St. Paul" from Kamchatka to the Alaskan Coast and Return, 1741. By Captain E. P. Bertholf. Scale, 1:5,500,000.

(Accompanies "Bering's Voyages," Vol. 1. A modern reconstruction of the tracks of the two vessels of Bering's second expedition, based on the log books and other original records and adjusted to known physical conditions.)

*Forthcoming Publications*

1. Soils and Vegetation of Africa. By C. F. Marbut and H. L. Shantz.

(Available for distribution on April 20. Illustrated by maps of the soils, vegetation, land classification, and rainfall of Africa, and published jointly with the National Research Council.)

2. Aids to Geographical Research: Bibliographies and Periodicals. By John Kirtland Wright.

(Designed as an aid to research and locating published materials on a given subject.)

3. Geographical Lore of the Time of the Crusades: The State of Geographical Knowledge and Tradition in Western Europe during the Twelfth and Early Thirteenth Centuries. By John Kirtland Wright.

(A study in the history of geography.)

4. New York Walk Book. By Messrs. Torrey, Place, and Dickinson.

(A description of the scenery about New York and the roads and trails that provide access to open places. The book is in the general style of Dr. Dickinson's booklet on Palisades Interstate Park.)

5. The Land Systems of Mexico. By George McC. McBride.

(An intensive study of the use of the land and its geographical relations.)

6. Studies in the Cartography of the New World. By George E. Nunn.

(A technical study of certain geographical questions in the time of Columbus.)

7. DESERT TRAILS OF ATACAMA. By Isaiah Bowman.
(A field study of border settlements in the desert valleys and highlands of central-northern Chile and northwestern Argentina, illustrated with many photographs and maps.)

As a result of observations made in 1921 on the study trip referred to last year, supplemented by information from printed sources, Mr. W. L. G. Joerg, Editor of the Research Series, prepared a report on recent geographical work in Europe, which appeared in the July number of the *Geographical Review*. The status and present tendencies of modern geography in the twenty-two countries of Europe, excepting Russia, in which the science is represented are discussed in this report, and in the case of some countries, such as Spain and the Netherlands, about which little is generally known of this matter, a brief history of the development of the subject is given.

The sixth joint meeting of the Association of American Geographers and the Society was held at the home of the Society on April 28–29, 1922. The conference, which was well attended, included guests from several government departments and from foreign institutions.

The number of Fellows of the Society is 4145, of whom 408 are Life Fellows. In addition, the Society in recognition of special services to geographical science elected to Honorary and Corresponding memberships the following persons:

*Honorary Members*

Lieutenant-Colonel Sir Thomas Hungerford Holdich
Major-General A. W. Greely
Professor Lucien Gallois

*Corresponding Members*

Gunnar Andersson
Charles Raymond Beazley
José J. Bravo
James Henry Breasted
Jean Brunhes
Henry Chandler Cowles
Baron Gerard De Geer
Albert Demangeon
Guillaume Grandidier
David George Hogarth
Mark Jefferson
Curtis Fletcher Marbut
Olinto Marinelli
John Linton Myres
Charles Rabot
Sir Aurel Stein
Lieutenant-Colonel Jean Tilho
Frederick Jackson Turner
Robert DeCourcy Ward

The report of the Treasurer annexed hereto gives a condensed balance sheet and a summary of the general income and expenses of the Society. The work of the staff has been conducted with zeal and efficiency which deserve the highest commendation.

By order of the Council.

PHILIP W. HENRY
*Chairman*

REPORT OF THE TREASURER FOR 1922

*Receipts and Expenses*

| | |
|---|---|
| During the year there has been received from annual dues, interest on investments, and sales of publications | $67,128.23 |
| There has been expended for salaries, house expenses, library, meetings, publications, postage, insurance, etc. | 82,507.37 |
| Balance carried to Capital Account | $15,379.14 |

*Condensed Balance Sheet, December 31, 1922*

| | | | |
|---|---|---|---|
| Cash | $21,838.12 | Capital Account, Balance | $875.32 |
| Sundry balances | 304.95 | Annual dues paid in advance | 3,240.00 |
| | | Sundry deposits and reserves | 13,085.25 |
| | | Monograph Publication Fund, Balance | 2,812.54 |
| | | Hispanic-American Research Fund, Balance | 2,129.96 |
| | $22,143.07 | | $22,143.07 |

HENRY PARISH
*Treasurer*

REPORT OF THE SPECIAL COMMITTEE

The Special Committee appointed December 21, 1922, to nominate and invite suitable persons to fill vacancies which will occur in the offices of the Society at the date of its annual meeting in January, 1923, respectfully report that they recommend the election of the following gentlemen to the offices designated:

| | | TERM TO EXPIRE IN |
|---|---|---|
| *President* | John Greenough | January, 1924 |
| *Vice-President* | Philip W. Henry | January, 1926 |
| *Domestic Corresponding Secretary* | W. Redmond Cross | January, 1926 |
| *Treasurer* | Henry Parish | January, 1924 |
| *Councilors* | Madison Grant<br>Grenville Kane<br>Franklin D. Roosevelt<br>Paul Tuckerman<br>Roland L. Redmond | January, 1926 |

Hamilton Fish Kean
W. Redmond Cross
H. Stuart Hotchkiss
*Committee*

# GEOGRAPHICAL RECORD

## NORTH AMERICA

**Growth of the Reindeer Industry in Alaska.** The potentialities of a great reindeer industry in Arctic America envisaged by Mr. Stefansson (see the review of "The Northward Course of Empire" elsewhere in this number of the *Review*) have been amply demonstrated in the Alaskan portion of that region. It is little more than thirty years since the first reindeer were introduced into Alaska. Today an estimate of the herds places the number at 200,000 animals, while another 100,000 have been killed for food and clothing.

Although transplanted so recently, the reindeer industry in Alaska shows considerable and increasing divergences from Old World forms (compare the article by K. B. Wiklund: The Lapps in Sweden, pp. 223–242). When introduced, the industry was intended solely for the benefit of the Eskimos; but in the natural course of events it has passed more and more into the hands of the whites. Already a quarter or more of the reindeer are under white ownership. The Eskimos were taught methods of reindeer management by Lapp herders whose methods in the first place were primarily adapted to conditions in northern Scandinavia and in the second place rested in a measure on old customs and superstitious beliefs. To put the industry on a commercial basis calls for the adoption of modern methods, and to this end the Biological Survey of the United States Department of Agriculture established in 1920 a reindeer experiment station at Unalakleet on the shores of Norton Sound (Seymour Hadwen and Lawrence J. Palmer: Reindeer in Alaska, *U.S. Dept. of Agric. Bull. No. 1089*, Washington, D.C., 1922).

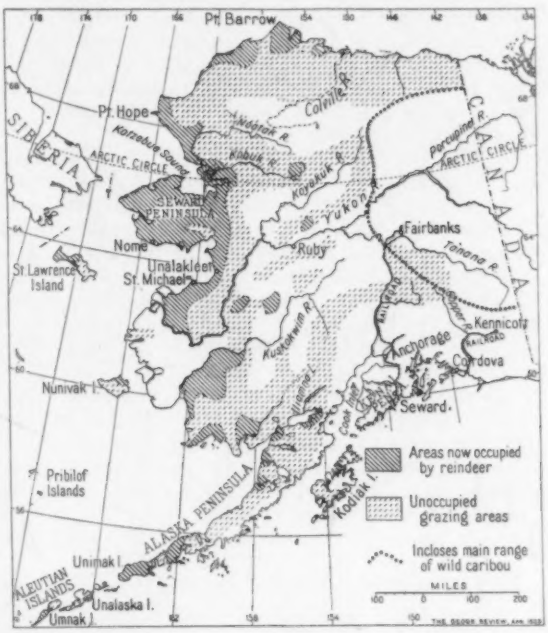


FIG. 1—Map showing reindeer grazing areas in Alaska, redrawn from the "preliminary" map on page 21 of Hadwen and Palmer's report.

The principles of handling stock in the Western States are generally applicable to herd management in Alaska. Unlike the close herding practiced by the Lapps, open herding similar to that of range cattle is preferred. In part because of the habits of the Eskimo and the existence of larger natural grazing units affording seasonal ranges, the tendency is towards the establishment of permanent ranches instead of the nomadic industry of the Mountain Lapps.

As a result of a preliminary survey it is estimated that there are 100,000 to 200,000 square miles of grazing lands available and that these are capable of supporting 3,000,000 to 4,000,000 reindeer. The grazing lands fall into two main classes: (1) the coastal areas and islands with summer grazing near the shore where salt can be obtained and comparative freedom from insect pests and (2) interior grounds with summer grazing on windy mountain tops. The best lands in the latter class are to be found at elevations between the timber line (2700 feet) and the snow line (6000 feet). At present, as may be seen from

the map, grazing is confined almost entirely to the coast region. Extension into the far interior will be in part dependent upon improvement of transportation. A step in this direction is the railroad from Seward to Fairbanks.

**The Progress of Mining in Canada.** An outline of the history of Canadian mining was given by J. B. Tyrrell before the Boston meeting of the American Association for the Advancement of Science (*Science*, No. 1463, Vol. 57, 1923, Jan. 12, pp. 31–38).

The first mining venture in Canada took place in the later sixteenth century as a result of the reputed discovery by Martin Frobisher of gold on Baffin Island. Nothing, however, came of it; and the scene of the enterprise was not revisited for three centuries. It is interesting to note the possibility mentioned by Dr. Tyrrell that Frobisher's gold-bearing "black rock" may have belonged to the Keewatin or Pre-Cambrian Series now yielding such large quantities of gold in the Porcupine district of Ontario. In 1672 the occurrence of coal near Sydney, Cape Breton, is mentioned—the first record of coal on the American continent. In the succeeding two centuries many discoveries of minerals and ores were made at widely scattered localities throughout Canada, but actual production remained small until the new era of transportation commenced with the completion of the Canadian Pacific Railway in 1885.

In 1886, the first year for which an accurate statistical report on mineral production is available, the total mineral output barely exceeded $10,000,000. From this time, and notwithstanding the fluctuating production from some of the spectacular mineral discoveries, the quinquennial reports show steady increase in production. Discoveries following the systematic exploration of the Rocky Mountains region, begun by Dawson about this time, helped to a doubling of production in 1895. In 1900, as a result of the Klondike discoveries, production had risen to $64,000,000. The next decade saw the opening up of the Cobalt silver district, and production reached $106,800,000. This figure was more than doubled ($228,000,000) by 1920. It marks a large increase in the non-metallic products, especially coal, and the spectacular development of the Porcupine and Kirkland Lake gold deposits of northern Ontario. It is expected that the output of these mines for last year (1922) will amount to $21,000,000, and for the whole of Canada $27,000,000, making the Dominion the third gold-producing country of the world.

It seems likely enough that this remarkable progress will continue. Most of the mines now worked are situated in or not far from the confines of the southern border belt of Canada. Beyond that border belt, population is of the scarcest; and transportation is slow and imperfect. A vast new country still waits mineral exploration.

**Peat Deposits of the United States.** Investigations made during the war show a considerable increase in the estimated peat resources of the United States (E. K. Soper and C. C. Osbon: The Occurrence and Uses of Peat in the United States, *U. S. Geol. Survey Bull. 728*, Washington, D. C., 1922). The figure (exclusive of Alaska) is now placed at 13,827,000,000 tons of air-dried peat. The greater part of the deposits occur in the northern and northeastern part of the country, roughly within the area covered by the last ice sheet. Here ponds, marshes, and lakes of the drift-covered surface provide a suitable topography, and climatic conditions of relatively low temperatures and high humidity in the growing season also favor peat formation. The northern or "glacial" area is approximately defined on the west by the 20-inch line of annual rainfall—about the 97th meridian—and on the south by the July isotherm of 75° F. (see map on scale of 1: 7,000,000 accompanying the report). Ideal conditions prevail in the Great Lakes States, and here the bulk of the peat is to be found. Minnesota, Wisconsin, and Michigan together contain 10,335,000,000 tons, or nearly three quarters of the total resources of the country. The largest single deposit, covering 4000 square miles in Minnesota, lies in the basin of the ancient Lake Agassiz. New England, especially Maine and Massachusetts, contain many climbing bogs, in which the peat forms on flat or gently sloping moist areas as distinct from areas under water, and much sphagnum peat.

Apart from the Great Lakes region the largest areas of undrained lands are to be found along the Atlantic coastal plain and the Mississippi valley (cf. O. E. Baker: Land Utilization in the United States, in the January number of the *Review*). The latter region is unsuited to peat formation because of the amount of sediment carried by the water and the unequal distribution of rainfall throughout the year. On the other hand, the rainfall and humidity of the Atlantic seaboard are favorable; and deposits have formed in the

drowned valleys and lagoons resulting from subsidence of the coastal plain and in the flat, imperfectly drained areas inland. The largest deposits occur in Virginia, North Carolina, and Florida, the last named state containing 2,000,000,000 tons of good-quality peat. Peat is also found in a narrow belt along the Gulf coast.

**Routes to Desert Watering Places in the Southwest.** Everyone interested in desert landscapes, in relief and vegetation, and in the distribution of desert life in general will be grateful for four admirable papers on routes to desert watering places in the Southwest ("Routes to Desert Watering Places in the Salton Sea Region, California," by John S. Brown; "Routes to Desert Watering Places in the Mohave Desert Region, California," by David G. Thompson; "Routes to Desert Watering Places in the Lower Gila Region, Arizona," by Clyde P. Ross; and "Routes to Desert Watering Places in the Papago Country, Arizona," by Kirk Bryan, *U. S. Geol. Survey Water-Supply Papers 490-A, 490-B, 490-C, and 490-D*, respectively, Washington, D. C., 1920–22. Mr. Thompson's report was reviewed by Prof. W. M. Davis in the *Geogr. Rev.*, Vol. 12, 1922, p. 155). Not the least valuable part of this enterprise of the Geological Survey is the striking series of maps accompanying the reports. When these maps are assembled they give one a vivid picture of a part of the real American desert in the Southwest which occupies on them a strip about 500 miles from southeast to northwest and about 250 miles from southwest to northeast. The maps embrace the Mohave Desert, the Salton Sea region, a part of the lower course of the Colorado River, and portions of the block-mountain type of relief characteristic of southern Nevada. They lie in those portions of the "basin-and-range" province designated by Fenneman as the Sonoran Desert and the Salton Trough (N. M. Fenneman: Physiographic Divisions of the United States, *Annals Assoc. Amer. Geogrs.*, Vol. 6, 1916, p. 42).

The maps display a wide range of desert relief. West and northwest of the Salton Sea are the broken slopes of the San Bernardino and subsidiary mountains. In the Mohave Desert region farther north are scattered hills and clusters of half-buried mountain ranges, while east of the Colorado the filling of the desert basins has been carried to the point where only the tops of the mountains protrude above a vast plain of waste. In form the mountains range from the irregular dissected slopes west of the Salton Sea to the well-defined block mountains lying at the eastern border of the Mohave Desert that continue the type of structure and relief characteristic of the mountains of Nevada. Again in the region east of the Colorado and immediately north of Mexico the burial of the mountains has gone so far that only the crest lines rise above the plain of waste. In addition, the blocks of this district, once with short, steep slopes on the one side and long and gentle slopes on the other, have now been eroded in many cases over so long a period of time that the two slopes have become nearly if not quite equal.

The relief shading upon the maps, which is one of their most useful features, has been done by John H. Renshawe, who has mastered the special technique required and produced a series of maps of which these are perhaps the most striking example. He has employed three tints that give hypsometric values with great clearness and fidelity. The lowest depressions are represented by the darkest shading, which is a reversal of the general scheme to which we have been accustomed. The slopes of the mountains above the desert plain are represented by a shade of brown distributed in the conventional way, with the light in the upper left-hand corner and broken, of course, to fit the relief of the mountains, which still further lightens the shade. The highest slopes and summits of the mountains are represented by the lightest of the three shades employed. The effect of Mr. Renshawe's treatment is happy in all respects. The general appearance of the relief closely resembles the appearance of the desert landscape just before sunset, when the shadows have gathered upon the plains and in the ravines on the eastern side and the summits and western slopes are yet in full sunlight. The resemblance to the sunset effect is all the more striking because in the desert the noonday sun sheds too bright a light for the desert forms to be clearly visible. They are overlighted, and relief effects largely disappear. In this respect overlighting in the desert conceals the relief to the degree to which haze conceals it in the humid air of our eastern mountains.

The present four papers are described as "abbreviated guides." Brief summaries of the physical features, settlements, roads, means of travel, forage, and the like, with suggestions to motorists respecting clothing, fuel, etc., are followed by road logs and short notes on the watering places. Reports giving detailed information on the watering places and comprehensive descriptions of the geography, geology, and hydrology of the region are in prepara-

tion. For the belt east of the Colorado River it is worth referring at this time to the cross sections, geological descriptions, and topographic analyses given in Willis T. Lee's report of 1908 (W. T. Lee: Geologic Reconnaissance of a Part of Western Arizona, *U. S. Geol. Survey Bull. 352*, Washington, D. C., 1908). For the vegetation and other matters of biological interest there is still no better report than the excellent one by Mearns to which reference may be made (E. A. Mearns; Mammals of the Mexican Boundary of the United States: A descriptive catalogue of the species of mammals occurring in that region, with a general summary of the natural history and a list of trees, *U. S. Natl. Museum Bull. 56, Part I*, Smithsonian Instn., Washington, D. C., 1907.) The maps accompanying the guides show all details regarding *water*—lakes, streams, wells, reservoirs, springs, etc. The conclusion of this great work ought to have an immediate effect, for the region is now accessible for tourists; and no doubt development also will be hastened, though the possibilities are very meager.

**New Relief Maps by the U. S. Geological Survey.** The Geological Survey is producing a series of extremely useful maps with the relief represented in three shades of brown. The shades are employed with a hypsometric effect, the lowest depressions having the darkest shade and the highest elevations the lightest shade. We have referred to this in the note above on the desert watering places of the Southwest. There the employment of the technique developed by John H. Renshawe could be made particularly effective because of the contrast between half-buried mountain and adjacent flat plain. One of the series is entitled "Relief Map, State of Ohio," scale 1:380,160, and over much of the area the relief is so slight as to furnish a severe test of this method of relief representation. The effect is as striking and the interpretation of the relief as faithful as in the case of the contrasting mountains and plains of the Southwest. The successive concentric terminal moraines with their closely associated sympathetic drainage lines southwest of Toledo constitute one of the most instructive features of the map. In great contrast to the trend and pattern of the drainage of northwestern Ohio as fashioned by the Erie lobe of the Wisconsin ice sheet is the drainage and relief of the central part of the state, where the preglacial topography is more strongly expressed. A little more than the eastern third of the state is included within the Appalachian plateaus, and here the effect of glaciation has been very slight as compared with its effect in northwestern Ohio. To bring out these three main divisions of the state within so narrow a range of relief is to have achieved a striking success.

The quality of relief shading is well shown on the Monument Spring quadrangle of Texas. The map was produced with brown contours; it was then shaded in a more nearly conventional way, with the light coming from the left or the upper left, all of the eastern slopes being represented with the darkest shade of brown. This left the mountain summits and the plains more nearly alike, with the mountain summits the lightest of all. The experiment was conducted in part as a means of helping the layman and the army officer, for example, to read the relief perhaps more readily than could be done from the contours alone. The shading on this quadrangle differs from that used upon the map of Ohio and the Mohave Desert by having no hypsometric gradations.

## SOUTH AMERICA

**A Vegetation Map of the Peruvian Andes.** Dr. August Weberbauer has published a map of the vegetation of the Peruvian Andes between latitudes 4° 30′ and 17° S. and extending from the Pacific coast to the Amazon plain (*Petermanns Mitt.*, Vol. 68, 1922, pp. 89–91, 120–122, and map 13). The scale of the map (1:3,000,000) and the color scheme adopted permit of a rather detailed drawing of the outlines of the various formations, of which there are twenty-five; and narrow strips as well as isolated patches of less than ten square miles are clearly visible. The work is apparently based upon extensive exploration by the author as well as upon the researches of others, and, in addition to being of great value to students of regional botany, it is to be considered as an important contribution to the geography of South America. Not only does it enable us for the first time completely to visualize an important element in the landscape—the vegetation, but in a country where meteorological stations are few and far between we have before us an index to the varied climatic zones of Peru much more accurate than any hitherto available. Moreover, since the types of agriculture associated with each natural formation are known, this map brings

us nearer, by a large step, to an adequate cultural map of Peru. We are led to hope that research along two lines will now proceed quickly and so render Dr. Weberbauer's work still more useful. The researches needed are botanical and cartographic. The first, by determining with precision the conditions of climate and soil needed by plants typical of each formation as well as the range of these, might advance climatic studies in an important measure; and there is little hope of an equal advance due to extensive meteorological study. The surveyor and cartographer can and will produce a much better map of Peru than the one upon which the present map is based and so permit of a redrawing of the vegetation—and other features—more accurately and on a larger scale.

The twenty-five formations of the author may be described in summary as follows:

1. *Algarroba groves;* including agricultural areas replacing them; hydrophilous; characterized by *Prosopis juliflora*, a prickly evergreen; occurring in the coastal desert valleys between 6° and 7° and between 14° and 15° with and without temporary herbaceous vegetation according as rain is rare or annual. [Cf. division between (5) and (6).]
2. *Mixed river-bank bushwood of the coastal zone*, including agricultural areas replacing it; hydrophilous; various trees, shrubs, and reeds, probably originally occupying narrow strips in the desert on all streams save those mentioned above.
3. *Desert;* in some places with isolated plants such as gray Tillandsias and lichens nourished by dew and mist; less frequent north of 11°, where moisture is rarer. Fifty kilometers are often passed without seeing a plant; from 6° 45′ this desert is broken only by stream-bank oases (1) and (2).
4. *Lomas vegetation;* of the Lomas, or coastal hills, between ocean and desert; xerophilous; nourished by the *garua* (coastal fog) alone; a mixed herbaceous vegetation consisting mainly of delicate, thin-twigged shrubs and some grasses. Southward from 10° 30′ it forms an almost continuous strip, the two chief gaps being at about 14° and 15° 30′.
5. *Scattered evergreen ground-water woods;* xerophilous; occupying the coastal zone north of the desert but best developed north of 6°. As the rainless period is often 20 years long, there is no herbaceous vegetation between the bushes and stunted trees of *Prosopis, Capparis, etc.*
6. Like (5); xerophilous, but with herbaceous vegetation between bushes, due to sparse summer rains; including also certain deciduous trees; occupying the higher ground inland from (5) north of 6° 30′.
7. *Open, mixed xerophilous vegetation;* of cactus, especially pillar varieties, and deciduous shrubs, but no trees; forming a continuous zone on the lowest western slopes of the Andes from 8° southward; its upper limit varying from 2500 m. in central Peru to 3600 m. in the south; found also in strips along some of the interior valleys.
8. Like (7); xerophilous, but with small deciduous trees (*Bombax*, etc.) and much grass; occupying interior valleys such as the upper Marañon and Apurimac; upper limit rising either southward or upstream in each locality, thus: on the Pacific slope (between 5° and 7° 30′), from 250 m. to 1800 m.; in the Marañon valley, from 1500 m. to 2300 m.; in the Mantaro valley, from 1800 m. to 2100 m.; in the Apurimac system, from 1800 m. to 2400 m. The increasing altitudinal limit of this xerophilous formation corresponds to decrease in moisture.
9. *Savanas;* macrothermal and xerophilous, rainy-green grass steppe with isolated deciduous trees and shrubs—closing to woods along streams—and very little cactus; in the valleys of the Mantaro and Apurimac (1600 to 1800 m.) and Urubamba at about 1500 m.
10. *Macrothermal deciduous (xerophilous) woods;* of bush and shrubs, including cactus, alternating with rainy-green grass steppe. The distribution of wood is independent of streams; occupies valleys of Marañon to 900 m. and of Quirós to 2000 m.
11. Like (10); xerophilous, but of woods seldom interrupted by steppes; cactus common; between 4° 50′ and 7° on the Pacific slope (900–1600 m.) and in valleys (1500–1800 m.).
12. *Transitional vegetation;* xerophilous and between macrothermal and mesothermal; consisting of rainy-green bushwood, often with much grass and in places interrupted by rainy-green steppe; narrow strips generally sandwiched between lower, drier formations and higher, moister formations (often between (8) and (19)); on the

Pacific slope between 7° and 8° and in the inter-Andean valleys south of 6° 40′. Its limits are from 1500–2400 m. (lower) to 2500–2900 m. (upper). The upper limit of tropical agriculture lies in this zone.

13. *Mesothermal rainy-green steppe;* with isolated (subxerophilous) shrubs (cactus absent); continuous on Pacific slope from 8° to 14° 30′ and in upper basins of the Marañon, Mantaro, and Apurimac; lower limit from 2500 m., rising southward to 3400 m.; upper limit 3800–4000 m.
14. *Mesothermal tola heath;* subxerophilous; characterized by the evergreen composite shrub *Lepidophyllum quadrangulare;* alternating with formations of other narrow-leafed shrubs and grass steppes with isolated shrubs; almost entirely on the Pacific slope from 14° south. Upper limit about 4000 m., lower limit varying from 3200 to 3700 m.
15. *Microthermal tola heath;* mixed with the high Andean (shrub-free) formation. Tola continues as in (14) up to 4200 m. but is accompanied by cushion-like plants instead of the mesothermal shrubs and corresponding agriculture.
16. *Typical high Andean formation (microthermal);* cushion-and rosette-shaped plants; occasional squarrous shrubs; highest stature reached in occasional groups of *queñoa* (*Polylepis*); covering the high plateaus in a belt narrowing gradually northward and terminating at 8° 20′.
17. *Microthermal grass steppe;* practically evergreen. Where not used for pasture and regularly burned, grass is very thick, as dead blades do not decompose quickly. Replaces (16) in moister situations and extends down to 3400 m.; forms a nearly continuous zone on the highest eastern slopes of the Andes and prolongs the central zone of (16) northward; northern limit about 6° 30′.
18. *Glaciers and permanent snow;* occupying relatively very small patches.
19. *Mesothermal transitional formation;* between those of subxerophilous and hygrophilous character; consisting of rainy-green grass steppe with much shrubwood partly evergreen; more shrubwood and more periodicity than in (13) but less than in (23); occupying slopes in the interior basins of the Amazonian rivers between 2500–2800 m. and 3700–3900 m.
20. *Transitional formation;* between macro- and microthermal; consisting of bushwood partly evergreen, partly rainy-green, and interrupted by rainy-green grass steppe; no cactus; occurring in strips below (19) in the same valleys and at varying altitudes but more extensive north of 7° where it reaches the Pacific slope. It is similar in several ways to (12).
21. *Bushwood, macrothermal, subxerophilous, and evergreen;* alternating with evergreen grass steppe. Occurring in patches within the forest limits on eastern slopes of the Andes and in a wide stretch west of the Huallaga River between 6° and 7°; upper limit from 1500 to 2000 m. The reason for the existence of this formation, with some xerophilous characteristics and no large trees, is in doubt—perhaps to be explained by soil poverty.
22. Like (21), but uninterrupted by grass steppe; a small occurrence noted in the Marañon valley just south of 6°.
23. *Evergreen woodland of the cloudy zone—alternating with grass steppes;* hygrophilous and mesothermal. The woodland varies between shrubwood and bushwood including hardleaved shrubs and lichens, mosses, and epiphytes; seasonal rhythm evident chiefly in the grasses. Occurs in strips on the eastern slopes of the Andes, northward to 6°, crossing the Andes between 5° and 6° and thence northward on the Pacific slope; upper limit 3400–3900 m., lower limit usually 2400–2600 m.
24. *Evergreen forest of the cloudy zone;* practically uninterrupted by grass steppe; the *Ceja de la Montaña* (eyebrow of the forest); hygrophilous and mesothermal; characterized by hard-leafed trees and by lichens, mosses, and epiphytes; undergrowth dense; seasonal rhythm scarcely evident. Occurs as a continuous strip on the eastern slope throughout Peru and on the central Andes north of 6° 30′; upper limit 3400–3800 m., lower limit 1800–2300 m.; occurs also on summits of eastern foothills, where it reaches as low as 1200 m.
25. *Tropical rain forest;* hygrophilous and macrothermal; trees completely dominant. On account of the small amount of light penetrating the tree crowns the undergrowth away from rivers and clearings is thinner than in (24) and consists mostly of young trees and lianas.

## AFRICA

**Further Evidence on Desiccation in Northern Africa.** A recent contribution to the desiccation theory of northern Africa (compare *Geogr. Rev.*, Vol. 11, 1921, pp. 622–623) is made by Mr. F. W. H. Migeod in the article "Some Notes on the Lake Chad Region in British Territory" (*Geogr. Journ.*, Vol. 60, 1922, pp. 347–359). Mr. Migeod expresses the opinion that not only is the zone of desiccation encroaching from the Sahara but that "the most alarming feature about it is the appalling rapidity of its advance." Various evidences of desiccation in the vicinity of Lake Chad—drying up of streams, of ponds and swamps, of wells, and of vegetation—are shortly discussed. The evidence of tribal movements is merely mentioned with the comments that "whenever a movement takes place, and a new village is founded, it is always to the south of its predecessor" and that each successive capital of the Bornu empire dating from six centuries back has been south of its predecessor.

Lake Chad itself is a salient into the drying zone, a protection to the fertile grain-growing lands behind. The vast swamp represents the drainage from two streams, the Shari from the south and the Yobe from the west. While there is no reason to believe that less water is brought down by the Shari, the Yobe, the greater part of whose basin lies in the zone of desiccation, has carried less and less water during the last thirty years. Coincidently there has been a general retreat of the lake shores.

A continuous process of desiccation in the lacustrine basin of the Niger above Timbuktu has been in progress since the middle of the last century. Colonel Mangeot, describing it in *L'Afrique Française* for December, 1922 (Le desséchement du bassin lacustre du Niger, pp. 524–526), expresses the opinion that the phenomenon is not due to diminution of rainfall at the sources of the river but is to be attributed to a cutting down of the rocky barriers which formerly ponded up the waters of the several lake basins.

**The Drought Problem in South Africa.** During 1918–1919 South Africa was visited by one of the worst droughts of recent years. The rainfall was less than in any year since 1903, and the losses to the farmers were extremely severe. Direct losses were estimated at not less than £16,000,000. The seriousness of the problem lies in the general trend towards desiccation whereby the situation during the recurring periods of drought is rendered increasingly precarious. This is emphatically stated by the Drought Investigation Commission which started work in 1920 and has lately published an interim report. (An outline of the report is given in the *Journ. Dept. of Agric., Union of So. Africa*, Vol. 5, 1922, Pretoria, pp. 118–130.)

As a preliminary the Commission establishes two facts: first, that a large part of South Africa was dry long before the arrival of the white man; second, that since his arrival large areas show increased dryness—rivers, waterholes, etc., dried up—because of denudation of the vegetative cover. In this second fact lies the basis of the findings and recommendations of the Commission.

Declining rainfall as a cause of desiccation has long been argued, but the Commission finds no evidence of such decline during recent historic times. As to a possible change in the nature of the rainfall, the Commission does not commit itself though admitting that this is "within the bounds of possibility." On the contrary it is indisputable that the "economic value," or efficiency, of the rainfall has diminished. "The rains of last generation fell on unbroken, understocked grazing lands and were more lasting in their beneficial results than rains of equal magnitude falling today on veld overstocked, tramped out, semi-waterproof, hard-baked by sun and veld fires."

Destruction of the veld is in turn attributed to the present system of stock farming, the harmful features of which are cumulative in their effects. Especially harmful is the general practice of kraaling, or concentration of the stock at night, which necessitates much driving of the stock by day with increased food requirement and trampling of the veld, an evil further aggravated by the lack of adequate watering places and by overstocking. Kraaling is necessitated by the depredations of the jackal. An essential step in reform is extermination of the animal, and the best means towards this end is the use of jackal-proof fencing.

Erosion of the vegetative covering also has its effect on agriculture, especially in relation to irrigation. The increasing frequency of river floods demands the creation of expensive protective works and leads to the silting up of reservoirs. The Commission recommends the immediate appointment of a Reclamation Officer to deal with the problem of soil conservation.

**Irrigation in South Africa.** In a paper under this title appearing in the December (1922) number of the *South African Geographical Journal*, Mr. F. E. Kanthack discusses the place of irrigation in the economic development of the Union of South Africa. Rainfall conditions are such that irrigation is necessary for agriculture over the greater part of the Union. Over 12 per cent of the area the rainfall is less than 5 inches; over 33 per cent it is less than 10 inches; and over 65 per cent, less than 20 inches. Furthermore, distribution is unequal, little rain falling in the critical months, August, September, and October. It is estimated that 90 per cent of the Union requires irrigation during September and October. At the same time irrigation possibilities are limited. The run-off from the rivers is small (see also the article "Some Notes on Rainfall and Run-off in South Africa," by J. R. Sutton, in the same number of the *Journal*), really big floods are not frequent, and evaporation losses are high. Topographic conditions are also unfavorable to the development of irrigation schemes on a large scale. Good soils are confined to the alluvium of some of the river valleys; in fact, it is doubted whether as much as two per cent of the total area can be classed as good or fair from the culturable point of view. Omitting the coastal zones of the south and east with sufficient rainfall for most crops and the area with a mean rainfall of less than 10 inches where irrigation possibilities are exceedingly small, the total area of irrigated and irrigable land may be estimated at 3,000,000 acres. It is suggested that the most economical use of much of this land would be for the production of high-grade fodder to supplement the pastoral resources of the veld whose stock-carrying capacity is limited (see preceding note).

**The Physical Geography of Portuguese Nyasaland.** This section of Portuguese East Africa stretches eastward nearly 400 miles from the southern part of Lake Nyasa to the Indian Ocean, between latitude 11° and 14° S., and has an area of about 80,000 square miles, about one-fifth of the entire colony. It is one of the least known and apparently one of the least valuable of the African territories according to R. R. Walls, who describes it in an article in the *Scottish Geographical Magazine* (Vol. 38, 1922, pp. 164–181). His description is rather vivid, but the explanatory remarks regarding the forms of the land do not always inspire confidence.

A light sandy soil and a thick tropical vegetation cover most of the region. A coastal belt, about twenty miles wide, consists of uplifted marine deposits in the nature of raised beaches, including coral rock, calcareous sandstones, and unconsolidated muds, in horizontal layers lying unconformably on older rocks. These older rocks, emerging westward, occupy the rest of the region; they are for the most part highly metamorphic gneisses and schists, including a prodigious amount of iron ore, along with quartzites or banded jaspers; there are also occasional intrusive granites. The rocks appear to have suffered great regional thrusts from the south and the east; the latter movements are "of recent geological date and may . . . be still going on." It is implied that the north-south basin of Lake Nyasa is due to these later deformations. Sufficient value is not, in the reviewer's opinion, ascribed to denudation as an agency in giving the present form of the region.

The surface, which rises gradually from the coast to the border of Lake Nyasa, is generally of moderate or small relief; but "here and there mountains rise abruptly from the level sandy plain" to a height of several hundred feet. These mountains are all of the nature of Inselberge—and this alone would suggest that the surrounding surface has been much lowered by degradation—like "petrified whales in a sea of sand." They are of four kinds: (1) isolated bosses of intrusive granite; these are rather common although granite occupies but a small share of the total area; (2) mountains of steeply folded gneisses and schists, forming long ranges, parallel to the rock foliation; the ranges are seldom continuous, but usually consist of a "number of isolated humps in line with one another"—and as such they must almost certainly be the residuals of a long-continued period of erosion; (3) sharp escarpments of quartzite, mostly in the south; (4) boulder mountains: these are said to occur "where regional compression has taken place in two or more directions not in line with one another, and the rocks [their composition is not stated] have broken up into huge boulders piled on top of one another." This explanation seems very questionable: the boulder mountains are probably like the Matopos of Rhodesia, the result of long-continued weathering and far-advanced disintegration.

Almost the only reference to denudation as a cause of physiographic features is a brief statement to the effect that the country "owes much of its characters" to the weathering of the rocks. Disintegration under sunshine is regarded as more powerful than chemical de-

composition. Rainfall, sometimes heavy, is almost limited to January and February. The rest of the year is dry and hot. Under the influence of powerful insolation, the rocks scale off in layers, often with an explosive report like a pistol shot, leaving a firm and smooth surface from which it is often difficult to hammer a hand specimen; further disintegration produces coarse sand in great quantity. The sand, sometimes cemented into a ferruginous rock, fills all the valleys; the intermittent rivers are choked by it. "The sand is, in short, leveling up the country again and obliterating the original corrugation of the land;" but this explanation is again very questionable in implying that the rock surface owes its form essentially to deformation. The same may be said of the statement, "The river valleys are wide and seem to suggest an immense drainage" at some former period: the important factor of time is not given sufficient consideration here, for with time small rivers may develop broad valleys. That deltas and mangrove swamps are encroaching on the shore may be well believed; but the large share attributed to faulting in shaping the coastal belt, which is said to have been unevenly uplifted to heights of 300 feet or more, needs confirmation: "it is humpy and broken and cut by innumerable faults, suggesting that it is being raised on the growing folds of the hard strata beneath." The best harbor, Pemba Bay, is described as enclosed by an upfaulted arm of land. The sea bottom is shelving, with numerous sand banks and coral islands. Terrific cyclones ravage the coast periodically—their season is not stated—and cause fearful destruction to life and property.

The region is evidently afflicted by its hot climate. It is a "place in the sun" with a vengeance. There are no natural resources from which an early return from invested capital can be expected. The half million natives are of a low order of intelligence and industry. Many of them have been converted to Mohammedanism by Arab and Indian settlers. The only thrifty element of the population seems to be the Indian traders, in whose hands lies the bulk of the traffic and who turn the alternation of seasons to their profit. They store the crops which they buy cheap from the natives at the end of the short wet season when food is plentiful, and then sell out at any price later on in the dry famine season. The improvident natives "die of starvation by thousands every year." Although Walls recommends irrigation, presumably by means of reservoirs, as a cure for the present discouraging conditions, it is to be questioned whether any such remedy will be introduced by the Portuguese, who seem unable to cope with the difficulties of the situation. They have not kept up various improvements introduced, apparently as military necessities, during the World War. Roads then made have been obliterated by the rapid growth of vegetation in the wet season; bridges have been washed away by rivers in flood; a steam sawmill has rusted into decay; a water-supply system for Port Amelia on Pemba Bay has been made useless by landslides in the soft muds of the coastal belt; at the end of 1920 a cyclone destroyed the pier, the hospital, and most of the houses of that attempted port; buoys which for a time marked the harbor shoals have disappeared. Verily, a territory without natural resources in a torrid climate would seem to be a possession hardly worth possessing.

W. M. Davis

## ASIA

**The Northern Sea Route to Siberia and the Norilsk Coal Region.** The sea route to the mouths of the Ob and Yenisei Rivers is destined to become one of the main commercial links between Siberia and the outer world. The practicability of this route from the technical point of view and its value from the commercial have been demonstrated without peradventure during the last few years. Annual expeditions—British, Scandinavian, Russian—have shown that the difficulties of navigation through the ice-blocked Kara Sea and through the great estuaries can be surmounted. (*La Géographie* for March, 1922, pp. 285–287, gives an account of an expedition of five steamers to the Ob and Yenisei in 1921 under the command of Otto Sverdrup.) Radio stations have been built to keep vessels informed regarding the position of ice floes and other obstacles. There has been talk of increasing the number of these stations and of supplementing them with airplane scout services. Navigation is bound to become safer and speedier, freightage and insurance costs to become correspondingly lower. Siberia's foremost economic problem has always been her poor facilities for export and import. The Trans-Siberian railway, which did more than anything else to open up the country commercially, is already overworked and will soon become wholly inadequate to meet the ever-growing demands made upon it. Other railways now projected may be completed in the course of time but only at great cost. The plan of a

system of canals linking together the upper reaches of the Siberian rivers and connecting them with the Volga and Europe on the one hand and with the Amur and Pacific on the other is still little more than an idle dream. The northern sea route, however, can be developed and improved at relatively slight cost. Even though navigation is open during a few short summer months only, freightage by this route will be far less expensive than by rail for unperishable commodities which can stand the delays occasioned by the long journey down or up stream and by the necessity of holding goods in storage throughout the winter at the rivers' mouths. Indeed, Danckwortt on page 57 of his "Siberien und seine wirtschaftliche Zukunft" (reviewed in this number of the *Geogr. Rev.*) maintains that freightage charges for shipping Siberian grain to London by the northern route may well amount to but half similar charges for shipments by rail to the Baltic ports or to Archangel and thence by sea to London.

The presence of coal deposits which form part of the immense Tungusk coal basin (see this number of the *Geogr. Rev.*, p. 289) near the lower course of the Yenisei will have an important bearing on the evolution of the northern sea route. The mining of coal in this remote district will make it possible for steamships engaging in trade by the northern route to fill their bunkers with Siberian coal for use on the return voyage instead of having to bring coal with them from Europe for this purpose. A saving of no less than 17 per cent tonnage can thus be effected.

Coal is found in the Norilsk region, about 50 miles to the east of the village of Dudinka on the lower Yenisei (see map in this number of the *Geogr. Rev.*, facing p. 292). The country between these deposits and the river and also extending some distance to the east was explored in 1919 and 1920 by an expedition sent out by the Siberian Geological Committee (which became in 1920 the Siberian Section of the Russian Geological Committee). The official report upon these explorations throws some new light upon the geography as well as the geology of this portion of northern Siberia (N. N. Urantsev: The Norilsk Coal-Bearing Basin, *Bull. Siberian Section of the Russian Geol. Committee* (*Izvestiya Sibirskago Otdeleniya Geologicheskago Komiteta*) Vol. 2, No. 1, Tomsk, 1921).

A map on a scale of 1: 210,000 accompanies the report. The map was based upon the astronomically determined geographical co-ordinates of four points (Potapovskoe village, latitude 68° 41′ N., longitude 86° 15.6′ W.; a point near the headwaters of the Dudinka River, latitude 68° 53.7′ N., longitude 87° 6.5′ W.; Norilsk coal fields, latitude 69° 19.6′ N., longitude 88° 8.′ W.; and Dudinka village, latitude 69° 24.9′ N., longitude 86° 9.2′ W.; magnetic declination at Potapovskoe: 21° 37.8′ E.) and upon reconnaissance surveys. It was also compiled in part from other maps, notably those contained in an atlas of the Yenisei made in 1919 from data obtained during an expedition under B. A. Vilkitsky.

The easternmost portion of the region explored forms a vast plateau of horizontal strata, the general level of the surface of which lies some 1700 to 2000 feet above sea level. The surface of this plateau is a peneplain now entering upon the initial stages of a new cycle of erosion. Farther west the borders of the plateau have been more maturely dissected by the streams flowing into the Yenisei, and consequently the relief is here fairly bold. The valleys have been cut to a depth of from 200 to 260 feet below the intervening hills and ridges. It is in this zone that the coal beds are found outcropping along the slopes. Still farther west a marshy plain, studded with low hillocks and diversified by numerous lakes, constitutes a belt some fifteen to twenty miles in width along the Yenisei.

The Yenisei itself is here a great, sluggish stream varying in width from three to seven miles. So slow is the current that the wind sometimes raises the level of the water ten feet and more. A recent gradual uplift of the continent or a relative lowering of the level of the Arctic Ocean has caused the Yenisei and its tributaries to excavate their channels to a depth of some 100 to 130 feet. During a brief period spring floods in the main river force the water in many of the tributaries to flow backward in an upstream direction.

The climate is typical of continental Arctic countries. The mean annual temperature at Dudinka, determined from observations made during eight years, is 13.1° F. The mean annual precipitation is 10.5 inches, with a maximum of 2.12 inches in September and a minimum in March. The ice in the Yenisei breaks up between May 25 and June 5, and the river freezes again between October 1 and 10.

The region for the most part is tundra. Scattered islands of larch (*Larix sibirica*) occur in the valleys, and the hilltops are crowned with dwarf birch and alder bushes (*Betula nana, Alnaster fruticosus*). Genuine forests of larch and to some extent of birch (*Betula tortuosa*) and spruce (*Picea obovata*) are found in the valley of the Norilsk River.

The natives are nomads who wander in summer toward the Arctic coasts and betake themselves in winter southwards into the forests. Further details about native life along the lower Yenisei will be found in an article by H. U. Hall in the *Geographical Review*, Vol. 5, 1918, pp. 1–21. Russian villages exist only along the main river at distances of twenty or more miles from one another and rarely contain more than three houses each. Even Dudinka, the "capital" of these extreme northern villages, has but twelve houses and only from sixty to eighty inhabitants

**History of the Post in China.** The history of the post in China is an interesting comment on the country's civilization. China has the most ancient of postal services. The system of government posts, *I Chan*, is mentioned in the records of the Chou Dynasty the beginnings of which date back 3000 years. For long the *I Chan* remained the only organized postal service. The Chinese, however, as H. B. Morse says, are essentially "a literary and commercial people and in both capacities a letter-writing people." By the beginning of the fifteenth century a system of private posts was in operation. These early companies originated in the province of Chekiang and developed into the powerful letter *hongs* that have served the people long and well.

From the national viewpoint the chief defect of the letter *hongs* was that they naturally developed only the profitable routes. The first suggestion for a truly national postal service came from outside, from Sir Robert Hart, Inspector General of the Imperial Maritime Customs. An attempt had previously been made to meet the needs of the foreign communities. The first post office along western lines had been opened in Hongkong as a branch of the London Post Office, and subsequently branches were opened in other ports with mail steamer connections. It was not, however, until 1896 that a national service was established by Imperial decree. The Imperial Post was then organized on western lines under Sir Robert Hart. In 1911 it was separated from the Customs, and the following year the work of the *I Chan* was merged with it. In 1914 China formally entered the Postal Union, and the latest step in the history of the postal service is the withdrawal at the end of 1922 of all foreign posts according to the provision of the Washington Conference.

Details of the modern development of the Chinese Post Office are given in the last official report (Report on the Chinese Post Office for the Tenth Year of Chung-hua Min-kuo (1921), Directorate General of Posts, Ministry of Communications, Shanghai, 1922). In view of the competition encountered against the government and private services and the difficulties of communication great progress has been accomplished. The records for 1920 show that 400,000,000 pieces of mail matter were posted and parcels to the weight of over 20,000,000 kilograms; there were over 10,000 post offices and agencies and about 233,000 miles of mail lines, of which about 158,000 miles were major courier lines. China has the longest overland courier line in the world, the 4400 miles from Peking to Tihwa in Chinese Turkestan. The romantic side of the Chinese Post is well depicted in the illustrations accompanying the report and showing the varied means of mail transportation—by wheelbarrow, mule litter, bullock cart, buffalo-skin raft on the Yellow River, camel from Kalgan to Urga, post boat up the Yangtze rapids, sledge in Manchuria, and finally the arrival of the first mail-carrying airplane from Peking to Tsinan.

**Chinese Geography of the West in Antiquity.** The history of the eastward spread of Western geographic knowledge in Antiquity and the Middle Ages has been made familiar through Sir Henry Yule's "Cathay and the Way Thither" and through the investigations of Henri Cordier. Its converse, the history of the westward spread of Chinese geographic knowledge, is less thoroughly understood, though the pioneer studies of Friedrich Hirth (in his "China and the Roman Orient," 1885) throw much light on this obscure subject. Albert Herrmann, in a paper entitled "Die ältesten chinesischen Karten von Zentral- und Westasien" (*Ostasiatische Zeitschrift*, Vol. 8, 1919–20, pp. 185–198), aims to supplement the work of Hirth "particularly on its geographical side." Herrmann's purpose is twofold, to reconstruct from Chinese documents certain maps of Central and Western Asia that presumably were drawn between the second century B. C. and the seventh of our era, and to interpret the geography which these maps presumably set forth.

The reconstruction of lost maps, as is all too well known from the bitter controversies that have long raged over Ptolemy and over the origins of the medieval *mappaemundi* and portolan charts, is an extremely hazardous business, made doubly hazardous, when, as in the

case of texts of the Han and Tsin Dynasties discussed by Herrmann, we have no definite assurance that the texts had any connection with maps whatsoever. The ground is perhaps a little surer when we turn to an early seventh-century treatise, where a map is distinctly mentioned. In any case judgment should be suspended in respect to the details of Herrmann's identification of place names until the matter has been more thoroughly threshed out by students of Chinese geography, philology, and history. However, it is probably safe enough to accept his outstanding conclusions.

The latter make it clear that the development of Chinese knowledge of the West bears some striking resemblances to the development of European knowledge of the Extreme Orient. Greek geographers of the Hellenistic period were often wont to assume that the eastern extremity of Asia and the ocean encircling the *οἰκουμένη* (or known world) lay not far beyond the confines of Iran and India. Similarly the Chinese of the early Han Dynasty

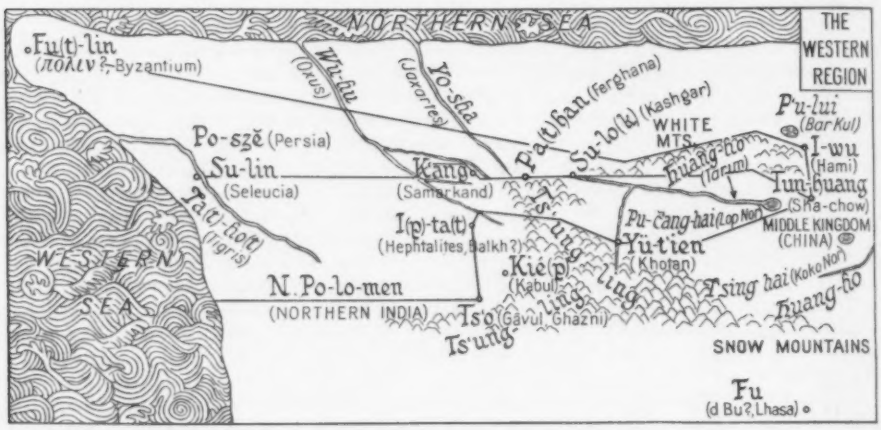


FIG. 1—Simplified outline of Albert Herrmann's reconstruction of a map which probably illustrated the "Memoir with Figures on the Western Region during the Sui Dynasty" written by P'ei Kü, 605–606 A.D. The straight lines on the map indicate three main highways from China to the Far West.

(206 B. C.–220 A. D.), looking across Asia from the opposite point of view, conceived of their *οἰκουμένη* as a rectangle surrounded by oceans. They placed its western shores somewhere in Turkestan. Among the Greeks there were many who thought it possible to sail from the Caspian Sea directly around to India. Correspondingly, a Chinese conqueror in 138 B. C., who had heard rumors of the Aral Sea and Persian Gulf, appears to have believed that these were connected with each other and together constituted the waters of the Western Sea. At a somewhat later period, through the collection of merchants' itineraries, much geographical information about Inner Asia was spread eastward to China and westward to the Roman world. From these sources Chinese scholars were able not only to gather together enough details to give a fairly comprehensive idea of the main cities and lines of trade of Central and West Central Asia but also to extend their view as far as the Mediterranean. From similar sources it seems likely that the Romans of the early empire and Marinus of Tyre obtained that shadowy knowledge of overland routes towards China or the land of the "Seres," which make such interesting reading in the "Natural History" of Pliny and the "Geography" of Ptolemy. It had thus come about that after ages of parallel development each oblivious to the other's existence, the peoples of the Mediterranean basin and of the Yangtze and Hwang Ho valleys were brought, at approximately the same epoch, within the geographic horizon each of the other.

Ta Ts'in, or Syria, which became known in China toward the close of the Han Dynasty, is described in an historical text dating from 437 A. D. as a peninsula and is compared with Shantung. An Tu, its capital city, is to be identified with Antioch.

On the early seventh-century map reconstructed by Herrmann a city of Fu(t)lin appears in the northwesternmost corner of the known world. Hirth believed that this represented Bethlehem, but Herrmann argues in favor of Constantinople, Fu(t)lin being perhaps a

Chinese rendering of the Greek word πόλιν. It is well known that the Turkish name of Constantinople, Istambul, comes from the Greek εἰς τὴν πόλιν.

This map on which Fu(t)lin appears shows Asia bounded on the north and west by seas. Into the northern sea flows the Yo-sha (Jaxartes), and Wu-hu (Oxus); into the western, the Ta(t)ho (Tigris). Three roads diverge from Tung-hwang (Sha-chow in the Gobi desert, 350 miles east of Lop Nor) and make their way in a generally parallel course to the Western Sea. The northernmost of these runs first to Hami and thence, turning westward, goes almost direct to Fu(t)lin, crossing the Jaxartes and Oxus on its way. The middle road, after passing places which Herrmann identifies with Kashgar and Samarkand, reaches the Tigris at Seleucia. The southern road passes through Khotan, Balkh, and Ghazni, to Northern India, placed to the south of Persia on the Western Sea! A glance at the accompanying figure will show that this is crude geography indeed, but it is no cruder than corresponding ideas that prevailed in the West at the time in regard to the geography of the Far East.

## GEOGRAPHICAL NEWS

**Eighteenth Annual Meeting of the Association of American Geographers.** The Association of American Geographers met at Ann Arbor, Michigan, December 27–29, 1922, for its eighteenth annual meeting. The sessions were held in the Natural Science Building by invitation of the Regents of the University of Michigan. The final program contained thirty titles, and all but four of the papers were duly read.

The full program together with abstracts of the papers will be published in the Annals of the Association of American Geographers, which is now issued in quarterly installments to members of the Association. All others will be furnished with gathered copies of the four numbers at the end of the year as heretofore.

Two papers in the final program were physiographic in character; three papers dealt with the subject of cartography; four had to do with climatology; and all the rest were in the field of human or regional geography. The Presidential Address of Professor Harlan H. Barrows dealt with "Geography as Human Ecology." Four papers in a group dealt with the Great Plains, their climate, vegetation, soils, and agriculture; and the group was introduced by a synoptical paper on land economics and followed by a round-table discussion of "Problems in Land Utilization." Through the courtesy of Mr. William S. Clements, one of the Regents of the University, the members of the Association and their guests had the opportunity of inspecting his notable collection of old maps and atlases.

The variety and character of the papers presented bore eloquent testimony to the vitality of the Association and its constant trend in the direction of human geography. From small beginnings nearly twenty years ago it has grown to be one of the substantial associations of scientific men in the United States.

# GEOGRAPHICAL REVIEWS

## The Economic Geography of Siberia

P. W. Danckwortt. **Sibirien und seine wirtschaftliche Zukunft: Ein Rückblick und Ausblick auf Handel und Industrie Sibiriens.** xii and 271 pp.; bibliogr. *Osteuropa-Institut in Breslau, Quellen und Studien, Section 7, No. 2.* B. G. Teubner, Leipzig and Berlin, 1921. 8½ x 6 inches.

Since the World War Germany has been looking eastward towards fields where she hopes ultimately to regain something of her lost commercial position and political prestige. If the doors leading to Africa and the Pacific are definitely locked against her ambitions, those of Russia, Siberia, and Central Asia may yet be opened, and she only waits to enter when the time is ripe. Meanwhile she purposes to survey the ground and to educate herself in everything that pertains to the lands beyond her eastern frontiers. One of the foremost agencies that she has created in order to carry out this program of self-education is the Osteuropa-Institut, founded in Breslau in 1918. The book before us is one of an elaborately conceived series of studies now being published by the Institut, a series which will deal with the geography, as well as the economic and intellectual life, of eastern Europe and the neighboring countries.

Danckwortt's volume is a veritable encyclopedic manual for the politician, trader, or investor, crammed full of detailed facts and statistical tables. Most of the latter date from before 1914, for the presumption is that any figures available from the period since the war are highly unreliable. The writer is severely sceptical of Russian estimates in regard to Siberian economic potentialities and claims that his conclusions are based either on personal observation or on the testimony of German prisoners; never on the verbal assertions of Russians.

After a preliminary regional sketch of Siberia as a whole and of Siberian internal and foreign commerce before 1914, Danckwortt writes in detail of climate, communications, agriculture, hunting, fisheries, mineral resources, and manufactures. He closes with some important observations on the history of Siberian industry since the revolution, its collapse at the fall of the Kolchak régime, and on German prospects in Asiatic Russia.

The book is more than a compilation of economic details. Danckwortt is embued with the spirit of the geographer as well as of the economist, and he envisages many of the economic problems of Siberia in terms of environment. The influence of environment is immediate, frequently all-powerful, in enormous and sparsely settled colonial tracts like Siberia. The extreme continental climate and the vastness of the area in proportion to the number of its inhabitants are the outstanding environmental elements in Siberian life. Danckwortt believes, however, that the climate is on the whole not quite as frightful as it has been pictured. We are prone to forget that Siberia covers over thirty degrees of latitude; that some parts of it are relatively mild; and, above all, that the warmth of the summers admits of agriculture at localities far to the north. Summer wheat may be grown at Yakutsk, no more than 400 miles from the cold pole of the world (Verkhoyansk, where the mean temperature in January is 58° F. below zero). Snowfall, nowhere very heavy in Siberia, is heaviest in the Altai Mountains and in the western *taiga* or forested zone. In the *taiga* the protection of the snow renders the cultivation of winter wheat more successful than on the open, windswept steppes farther south where the temperatures are higher. Much of Siberia is characterized by tracts underlain by "fossil ice," strata of earth that remain perpetually frozen below a thin covering of soil which thaws out in the summer. This "fossil ice" does not prevent the growth of trees or other forms of vegetable life. Indeed, through its retention of water, it may even be beneficial to plant life. The southern limit of the area of frozen earth is determined as much by the distribution of snowfall as by temperature. In the west, the border line is held far north by the snow that mantles the ground and retains warmth. Near Lake Baikal, however, the line swings southward to the Chinese frontier, leaving the whole of eastern Siberia, except the extreme southeast beyond Blagovyeshchensk, in the region of frozen earth.

The problem of communications over the immense expanses of plain and highland remote from the narrow thread of railway is intimately associated with climate. There are but few constructed roads in Siberia. Navigation on the rivers and with it the possibility of export by the northern sea route (see this number of the *Geogr. Rev.*, p. 309) is open for two months of the year only. On the other hand communication by land is facilitated by the freezing over of the lakes, streams, and swamps which in winter offer level and unobstructed highways.

Agricultural land, forests, and mineral deposits are Siberia's primary resources. Significant progress has already been made in agriculture, especially in the west. Before the war the export of butter from the plains east of the Ural had assumed no small proportions. Danckwortt prophesies that Siberia is destined to become a vast granary which will ultimately supply the outside world with breadstuffs. The forests are an immense and very slightly known resource. Stretching the whole length of the country from the Ural Mountains to the Pacific, they are broken here and there by swamps and meadows along the river valleys and by burnt-over tracts—for the forest fire is a curse in northern Asia as in Canada. The character of the forest varies widely with the region. In the Amur and Maritime Provinces heavier precipitation gives the woods a thickness of growth and luxuriance that is lacking farther to the west. The mineral deposits of Siberia are unquestionably very great; but they are not thoroughly explored, and we should be on our guard against exaggerated estimates of their extent or wealth.

Siberia's greatest needs are capital, labor, and improved routes of communication whereby her natural resources may be made available, and the manufactures fostered that are essential to the establishment of her present and future population on a sound basis. Only these will enable her to recover from the period of "industrial insanity" (as Danckwortt characterizes the Bolshevik régime) which she has gone through during the last few years.

Danckwortt believes that the Russians are incapable without aid from abroad of achieving economic prosperity in Siberia. He indulges in much comment that is possibly a little hypercritical on the visionary and impractical qualities of the Russian character. Nor does he ever fail, when he has the chance, to laud Germanic intelligence and enterprise, especially as shown by German and Austrian prisoners of war. It is not easy for us to accept at its full face value his vivid account of the stimulus which these prisoners gave to Siberian industry nor to believe that the economic breakdown and confusion that followed their repatriation was due altogether to their departure. Danckwortt sees Germany's opportunity in Russian incompetence.

But apart from its German bias, Danckwortt's book seems to be conservative and sound, an admirable introduction to the economic geography of a region about which reliable information is all too difficult to obtain.

## Regional Geography of the Balkan Peninsula and the Greek Mediterranean

Giotto Dainelli. **La regione balcanica: Sguardo d'insieme al paese e alle genti.** iv and 124 pp.; maps. Soc. An. Editrice "La Voce," Florence, 1922. 7½ x 5½ inches.

Otto Maull. **Griechisches Mittelmeergebiet.** 132 pp.; maps, diagrs., ills., bibliogr., index. Jedermanns Bücherei. Ferdinand Hirt, Breslau, 1922. 7½ x 5 inches.

These little books are models of compact regional description written for the layman by the professional geographer. In each, after some preliminary general discussion of the respective regions, physiography, climate, vegetation, and human geography are taken up in logical order. There is constantly kept before the reader's mind the relation between environment and human life and between the whole and its component parts. Influences of environment are not exaggerated, and due weight is given to historical and ethnographic forces in determining present conditions of life. Dainelli covers the broader field and aims to set forth in bold outline a relatively few essential facts and ideas. Maull has produced a work of finer texture. The German love of minute analysis appears in numerous passages in small type and in a detailed description of local regions forming Part II of "Griechisches Mittelmeergebiet." Maull's material, however, is well arranged and well expressed, and there is little danger that the reader will lose sight of the unifying structure of the argument through the meshes of its elaboration.

Dainelli frankly and generously acknowledges an immense debt to Jovan Cvijić. Indeed there is not much in his book which is not developed far more fully in the Serbian professor's fundamental "La Péninsule Balkanique" (Paris, 1918; see *Geogr. Rev.*, Vol. 9, 1920, pp. 199–204). On the other hand, the work of the Italian is in no sense one of servile imitation or of plagiarism, and there are many subjects in regard to which its author disagrees with his Yugo-Slav colleague. For instance, though in general accepting Cvijić's natural regions, he modifies their borders. National feeling is perhaps joined to zeal for truth in his rejection of Cvijić's claim that the Balkan Peninsula extends as far as the Isonzo in a northwestward direction. Dainelli places its northwest limit just short of Fiume. There is also possibly a trace of national feeling in his qualified acceptance of Cvijić's assertion that the patriarchal régime of the Balkan region cannot be regarded as belonging to an inferior status of civilization. If not inferior in an absolute sense, Dainelli says, it is relatively inferior, and very much so, to the majority of the other civilizations which have had their origins in or have penetrated into the Balkans. However, it must not be assumed from this that "La Regione Balcanica" is of a propagandist or tendentious character. It is the work of a geographer, not of a political agent.

Writing for his non-technical countrymen, Dainelli's purpose is to give as succinct account as possible of a region in which proximity and political contacts have aroused a deep interest. His primary concern is accuracy and lucidity of thought and expression.

Dainelli contends that the region as a whole should not be called a peninsula, that it has none of the well-defined homogeneity of the Italian and Iberian peninsulas, and that only south of the latitude of Corfu or Saloniki is it truly peninsular. This is more than a mere verbal matter, for in the uncertainty of its actual, as distinguished from its artificial, limits towards north and east may be found a clue to much Balkan history and geography. Danube and Save are not more real barriers to climatic, ethnic, and cultural influences than the Straits or the island-dotted Aegean. From the west, however, except for the Dalmatian coast, the Balkan region is difficult of access, and even from north and east only its fringes are easily penetrated. The heart of the region, owing to the broken character of the relief, subdivided by mountains and plateaus into countless separate valleys and inclosed basins, is an area of geographic fragmentation in every sense. The peoples and civilizations that have succeeded in penetrating this core of the Balkan world from the periphery, or from beyond, have all been shattered, Dainelli asserts, with much reason, as a result in large measure of the influence of the geographic surroundings in which they have found themselves, and are now represented in a multitude of isolated and often mutually hostile communities and cultural islands.

Dainelli's thesis is the lack of geographic unity of the Balkan region; that of Maull the remarkable geographic unity of a region which is partly included in the Balkan area but lies partly beyond its limits. The two books thus supplement each other. Maull's Greek Mediterranean region comprises the Hellenic Peninsula, the Aegean Sea with its islands and northern borderlands, and the western fringe of Asia Minor. The historical unity of this region in ancient times has often been emphasized; Maull professes to be the first to treat it as a closed and compact geographic unit. Much of the value of the book lies in the originality of this conception and the skill with which it is worked out.

Dainelli does not provide the selected bibliography and collection of photographs which form such useful features of "Griechisches Mittelmeergebiet." On the other hand, Dainelli's maps will probably be of more service to the average reader because the principle has apparently been followed that all names mentioned in the text shall be shown on one or another of the maps. Maull's maps, however, display an immense amount of special information in a very small space and well repay careful examination.

Would there were more books in English of the character and qualities of these!

### Among the Indians of Ecuador's Primeval Forests

Rafael Karsten. **Bland indianer i Ekvadors urskogar.** Vol. 1, 219 pp.; ills.; Vol. 2, pp. 221–406; map, ills. Söderström & Co., Helsingfors, 1921. 9½ x 6½ inches.

In these volumes Dr. Karsten, of the University of Helsingfors, gives a general account of his social and ethnographic studies during 1916 to 1919 in Ecuador, particularly in the Oriente. The travels were made on funds from Swedish and Finnish sources, and the greater part of his ethnographical collections have gone to the Museum of Gothenburg.

The Oriente has been little explored; few settlements are correctly placed on the map,

and the courses of the rivers are free interpretations (compare the article "Explorations in Eastern Ecuador," pp. 190–209 of this number of the *Review*).

Eastern Ecuador is described as one of the most beautiful regions in the world. Descending eastward from the Cordillera one first traverses the grass-covered high plateau and at an elevation of about 1500 meters passes into the tropical belt whose vegetation becomes more and more luxuriant as one reaches lower levels. Conspicuous are different kinds of palms; but it is particularly the richness of the undervegetation that gives the forest its character. On the Andean slopes the animal life is strikingly poor; but down on the Amazonian lowlands there is a teeming and variegated life, particularly abundant and colorful in the birds.

Of Indians Karsten visited the Colorados, living not far from Quito, and the Cayapas in the province of Esmeraldas; but most of his time was devoted to the study of the tribes in the forests of Oriente, particularly those living on the Pastaza, Upano, and Morana Rivers—the Canelos and Jíbaros. The Napo River was also descended as far as the confluence of the Aguarico.

The moral standard among the Indians not influenced by the white man's culture is very high. Crimes like homicide and theft are unknown in many tribes. The highly developed feeling for the community also expresses itself in great generousness, particularly in time of need. The boys are brought up in a Spartan manner, and the mode of life of grown people is very strict and governed by customs. Although as a rule the Indian does not express his feelings, he is far from being so hard as is generally supposed. In social respects the Indian woman is the equal of the man. In some tribes the women even exercise a sort of supremacy. At bottom the Indians are peace-loving. Their wars, in most cases, aim at revenge; and as soon as this is taken they are satisfied. Their sense of justice demands one life for one taken.

The Indians know a great many effective plant drugs, but practically they are rather poor medicine men and are exceedingly superstitious. (See also the article by Dr. Karsten "The Religion of the Jibaro Indians" in the *Bol. Acad. Nacl. de Historia* (Quito), Vol. 3, 1921, pp. 124–145, and Vol. 4, 1922, pp. 309–330.)

The legal position of the Indians who have come under the influence of the whites is the worst imaginable, and as a consequence these half-civilized and civilized Indians are morally far inferior to their "wild" brothers.

ERNST ANTEVS

## SNOWFALL CONDITIONS EAST OF THE BALTIC

J. LETZMANN. **Die Hohe der Schneedecke im Ostbaltischen Gebiet.** 65 pp.; maps, diagrs. *Acta et Commentationes Univ. Dorpatensis A: Math., Phys., Med.*, Vol. 2, No. 3. Tartu (Dorpat), 1921.

The present monograph comes as a welcome addition to the climatological literature of Europe. One of the deficiencies in our knowledge of European climates has been the lack of adequate data regarding snowfall, a deficiency that was especially brought home to the reviewer during the war, in connection with his studies of the climates of Europe in relation to military operations.

The district under discussion extends from the Gulf of Finland to the River Niemen. Observations of snowfall were begun there during the winter of 1890–1891. The number of stations fluctuated from year to year, reaching a maximum of over 100. Of these, 60 cover a sufficiently long period to be available in this investigation, which includes the years 1891–1910. The observations were made according to the regulations adopted by the Petrograd Observatory and included depth, the amount of surface covered by snow, the nature and appearance of the snow, the occurrence of snow squalls, etc. The data were all subjected to critical analysis and carefully scrutinized. The result is a complete and accurate presentation, both cartographic and tabular, of the snowfall conditions of the area under consideration.

The portion of the monograph of the most general interest is that which concerns the geographical distribution of the snowfall. The first decade of November usually brings the first permanent snow cover, of an average depth of over 0.5 centimeters at some of the stations. Scattered places have an earlier snow cover which, in some years, comes in October. In the first decade of December there is snow all over the district, averaging

from 1 centimeter to 10 or 11 centimeters. The coasts of the Gulf of Finland have the smallest amounts. By the middle of January depths of over 20 centimeters are found in a few places. The majority of stations have their maximum depths between mid-February and mid-March, there being a general increase in depth from the coasts inland. The greatest amounts are over 25 centimeters, mostly over the northern interior, back from the sea. By early May, in most years, there is no snow cover over 0.5 centimeters in average depth. Topographic controls are clearly indicated, especially in the south, the depth of snowfall increasing, as a rule, with increasing altitude up to 200–300 meters above sea level. There is also a close parallellism between the winter isotherms and the lines of equal depths of snow. Snow has fallen as early as September 21–22 (1866–1915). The 50-year records at the Dorpat Observatory show that July and August have been the only months without snowfall. The winter of 1899–1900 brought the greatest depths, averaging 24.5 centimeters. This amount seems insignificant when compared with the ordinary depths over much of the northern United States, but it must be remembered that the eastern Baltic region here under discussion has a modified continental climate owing to its position with reference to the adjacent water bodies.

It is a pity that the charts showing the mean depths of snowfall during the second decades of January, February, and March (the conditions between the 11th and the 20th being considered typical for the month) are not clearer and that the lines of equal depths of snowfall were not drawn on a base map showing the topography of the country.

R. DeC. Ward

## The Explanatory Description of Land Forms

Alfred Hettner. **Die Oberflächenformen des Festlandes.** viii and 250 pp.; index. B. G. Teubner, Leipzig and Berlin, 1921. 8½ x 5½ inches.

Alfred Hettner, professor of geography at Heidelberg, has revised and extended in book form a number of articles which he had previously published in the *Geographische Zeitschrift*, of which he is editor. The book, addressed to advanced students and experts, purports to be a discussion of the fundamental principles involved in the genetic investigation and explanatory description of land forms. The contents show a wide acquaintance with the literature of the subject and afford a large amount of profitable reading, often provocative of helpful reflection, this being especially true of the pages in which the history of land-form theories is traced; but the book as a whole is not so much characterized by novel and constructive suggestions as by homilies, truisms, hesitations, obstructive misunderstandings, and disputatious objections. It is a conscientious but reactionary protest against what its author regards as the too hasty methods of certain other geographers.

The following examples of homilies may be instanced. If a supposition as to the origin of a land form springs into an observer's mind, he must test it before accepting it (p. 14). Scientific investigation must be first inductive and analytic; that is it must set out from observed facts and, beginning with the simplest, test all possibilities of explanation before it can go so far as to establish an explanatory principle (p. 47). Theoretical deductions must be tested inductively by comparing them with observed facts (p. 32); this homily is held to be so important that it is stated twice again on later pages (pp. 167 and 214). Ideal block diagrams are to be recommended only when the ideas that they represent are correctly deduced; if the deductions are wrong, the diagrams are dangerous because they are so vivid (p. 246). Hettner solves this difficulty by using no block diagrams at all!

Among truisms are such statements as these. The earth's surface has been greatly modified by the action of superficial forces (p. 31). The side slopes of a valley are not the work of its stream but of weathering and soil creep (p. 33). The profile of a river is not controlled by fixed points at its head and mouth; the head point is worn lower as the river profile is developed (p. 37); it should have been added that the mouth point may be shifted forward by delta growth or backward by wave cutting. A knowledge of underground structure is necessary in studying surface forms (p. 142). Ancient peneplains, long buried and afterward stripped, must not be confused with peneplains of later origin (p. 150). Among the factors which determine the form of coasts is their age, that is the time during which they have been exposed to marine processes (p. 187). Homilies and

truisms of these kinds are well enough for beginners, but if they are needed by advanced students and experts one must wonder what sort of teaching such students and experts have previously suffered.

A number of well-established matters are inquired into in so deliberate a way as to suggest that the author has recently felt or still feels hesitation about their verity. The down-valley migration of river meanders is thought still to need further demonstration by observation, and a German writer is quoted as doubting its occurrence (p. 38); from this it would seem that pertinent facts, such as are presented on the two-date, large-scale maps of the Mississippi, and highly specialized forms such as are seen in the unsymmetrical spurs of incised meandering valleys like that of the lower Mosel were not known well enough to be appreciated at their proper value. Features as familiar as valley terraces are treated as if still needing explanation of their three origins; namely, the weathering of horizontal strata, the incision of a new valley in the rock floor of an older valley, and the accumulation and partial removal of valley-floor deposits (pp. 52–57); these pages would have been more helpful if, assuming a knowledge of the three classes of terraces, discrimination had then been made between terraces of weathering and of revived erosion in masses of horizontal structure, and if explanation had been given of the important part played by rock ledges in determining the cusps of alluvial terraces. The possible production of valleys by fractures instead of by erosion is still held to be worth combating (p. 27). Much is made of the long-established principle that the resistance of rocks to weathering is not to be determined merely by their physical strength, as under a hammer blow (p. 134); and here it is asserted that an observer follows circular reasoning who infers without further inquiry that the strata beneath a strike valley are physiographically weak. But, as a matter of fact, such an observer, if he is properly trained, is only making a pragmatically reasonable deduction from a well-grounded induction; for, after one has examined the strata beneath many strike valleys and found them to be well soil-covered, while the strata in the inclosing ridges exhibit firm outcrops along the ridge crests—scores and scores of such valleys and ridges occur in the Alleghanies between Catskill and Chattanooga—why should one any longer hesitate to use the resulting induction as a basis for future deductions regarding other strike valleys?

The explanation of certain mountainous highlands of geologically modern deformation as being now in a second cycle of erosion, introduced by broad uplift after advanced erosion in a previous cycle, is held to be only an untenable speculation (p. 110; also pp. 118 and 149). The well-authenticated facts that have compelled the two-cycle explanation are not examined. Instead of accepting this explanation as an important step of physiographic progress, Hettner approvingly quotes Supan as considering it a declaration of physiographic bankruptcy (p. 139).

Although the book is nominally devoted to the fundamental principles of land sculpture, it is in reality for the most part a diatribe against the scheme of the erosion cycle and against an American geographer who has for the past forty years interested himself in the development of that scheme. The name of this unfortunate individual is mentioned, usually with adverse comment, on the average rather oftener than on every other one of the 246 pages of the text; his method of thinking on physiographic problems is heartily condemned in nearly every respect. The condemnation is based partly on curiously insistent misunderstandings, some of which will be next instanced, partly on a disputatious preference for some other method than that of the erosion cycle for treating land forms, as will be shown in later paragraphs.

One of the most pervading misunderstandings results in the discussion of the "age" of land forms instead of their "stage" of development. "Davis' genetic terminology is based primarily on the age of land forms" (p. 233). "It sounds like a paradox, yet it is true, that the Davis school, in which age is the third term [in the description of land forms], makes no attempt whatever to determine the real age" (p. 141). As a matter of fact, not age but stage of development is the third term; and, although stage of development manifestly depends on the factor of time, it is practically determined not by measuring the geological periods during which a given feature has been undergoing erosion but simply by its visible form.

It is repeatedly insisted that the proper relation between induction and deduction, as expressed in the homilies above quoted, has not been observed in the exposition of the erosion cycle, which is said to be chiefly deductive (pp. 49 and 72); and this in spite of the abundant verifications by which nearly all the deductions of the cycle scheme have been

inductively tested. For example, at the close of a chapter in my "Erklärende Beschreibung der Landformen" which sets forth a series of elementary deductions—really for the most part based on inductions and given, as Hettner recognizes (p. 207), a deductive form only as a device of presentation—the explicit statement is made: "Whether the deductions are correct cannot be known until they are confronted with facts." In the next chapter the necessary confrontation is made, with the result of showing that while the deductions are as a whole correct they need modifications and extensions; and these are then proposed in a third chapter. But Hettner overlooks these verifications. In only one chapter of my book—the chapter on the arid cycle—was deduction carried far beyond observation; the reason therefor was explicitly announced to be the lack of sufficient descriptions of desert topography with which the deductions could be checked. Hettner, who has not traveled in desert regions, characterizes that chapter as "schematic and without meaning" (p. 213). Erich Kaiser, professor of geology at Munich, who has made a close study of the coastal desert of southwest Africa, states: "It is a region of the kind which Davis has deduced from the factors of an arid climate."

Hettner asserts that, with Davis and his pupils, the theory of peneplanation rests on a "geometrical construction" and not on observation of actual processes (pp. 94 and 95). In my own experience the theory of peneplanation first took form during the summer of 1883 in eastern Montana, where the broadly rolling plains, which cut the nearly horizontal strata at a small angle, are here and there surmounted to a height of 500 or 1000 feet by dike walls and lava tables, and where the essential processes of erosion, still in operation, are manifestly the ordinary processes of weathering and washing. A later experience on the plains of Siberia in 1903 confirmed the earlier one. The theory thus inductively originated is certainly not weakened because it is supported by deduction of a kind that Hettner derogatively calls a "geometrical construction."

Numerous disputatious objections are made to the plan of treatment adopted in the exposition of the erosion-cycle scheme. Among them are the following. It is insisted that the exposition should be opened with the consideration of detailed forms. That would be well enough for a summer course of study inductively based on field observations in a district of abundant and varied rock outcrops; but in a winter course of lectures for beginners in physiography at the University of Berlin, where a drift cover obscures all rock outcrops for miles around, it seemed to me preferable to begin with general principles of wide application, and to introduce details later. There would be little individuality in science, if everyone followed the same method of presentation. Objection is made also to the simple characterization of rocks as strong and weak, without mention of their composition (p. 134); but that was sufficient for introductory chapters; and in later chapters brief mention was made of chalk, clays, sandstones, granite, gneiss, lavas, and limestone. Hettner repeatedly urges that structure is not sufficiently attended to; yet "structure" is given first rank among the three chief factors which the recommended method of explanatory description should include. It is denied that this "method of structure, process, and stage," as it is briefly called, is "method" at all; it is said to be a "theory" (p. 189). But as a matter of plain fact it *is* a method and a well-ordered method, by which the theory of the erosion cycle is given practical application. The erosion cycle is condemned because it is "schematic" (p. 72). Of course it is schematic, as any other plan must be under which the immensely complicated facts of nature are intelligibly summarized; but it is not rigidly schematic, as Hettner implies; it is elastic and adaptable, and it may be elaborated as far as one wishes.

Emphasis is placed on the lack of new principles in the erosion-cycle scheme; it contains little that is original (p. 148). There has never been any question but that such factors of the scheme as upheaval, deformation, weathering, erosion, abrasion, and so on have long been familiar; whatever novelty the scheme may contain lies not in these factors but in their organized combination; and how far that is novel may be perhaps best judged by comparing Penck's chapters on "Die Erdoberfläche" in Scobel's "Geographisches Handbuch" in the editions of 1895 and of 1908; one is without any indication of the cycle scheme; the other adopts it fully. Yet a still stronger indication of the novelty of the scheme is Hettner's inability to do it justice, in spite of the time he has given to its examination; and also his blindness to the evident fact that practically all the refinements, the omission of which from a first half-year course to beginners he regrets, constitute natural extensions and additions which might be appropriately introduced in a second and more advanced course. Hettner would seem to prefer an all-at-once plan of presentation, which

should immediately set forth, along with fundamental principles, all sorts of complications in the way of varied rock composition, diversity of structure, irregular upheavals, alterations in the nature and rate of erosional processes with changes of climate, and so on. My preference is for a first entrance into the subject with simple examples and then a gradual advance to complex examples; on the firm foundation thus constructed one may later embroider as many elaborations as are desired. As a matter of practical experience, the general scheme of the erosion cycle presented in the introductory half-year course at Berlin gave its hearers more work than most of them accomplished; only a fraction of them found time to perform the practical exercises by which the lectures were helpfully supplemented.

W. M. DAVIS

## NEW ZEALAND LAND FORMS

C. A. COTTON. **Geomorphology of New Zealand. Part I—Systematic: An Introduction to the Study of Land-forms.** x and 462 pp.; maps, ills., diagrs., bibliogr., index. *New Zealand Board of Science and Art Manual No. 3.* Dominion Museum, Wellington, N. Z., 1922. 22s. 6d. 8½ x 5½ inches.

It has been remarked that, in a distant colony far removed from its mother nation, the element of remoteness tends to diminish conservative and to favor progressive legislation; a result to which emigrational selection contributes powerfully by keeping at home those of satisfied ambitions and of weak initiative and by provoking the departure of those having unsatisfied desires and the energy to satisfy them. The book above named, taken in contrast with certain books of the same object published in Europe, suggests that a similar consequence of remoteness may be found in science. The presence of preconceptions, preferences, and prejudices in an old country, where educational standards have been long established, may operate to retard the adoption of novel ideas and methods. Those grounds of objection to change have less force in a young country, where conventions are yet to be formed and where new ways of doing old things therefore may be freely judged on their merits and adopted if desired without encountering the opposition that is commonly aroused by the need of changing settled habits of thought.

Cotton's book is the work of a young physiographic geologist who for the past fifteen years has had abundant observational experience in New Zealand, who has carried into his richly varied yet compact field a trained mind unusually competent in the rational study of land forms and a skilful hand exceptionally successful in reproducing landscapes in simple outlines, and who, when it comes to describing what he has seen, has decided unequivocally in favor of a modern, genetic, explanatory method as against an old-fashioned and empirical method. Not only so: this decision does not remain an unapplied abstraction; it is given systematic application of the most practical and thorough-going kind in the book before us, where, after two introductory chapters on the science of geomorphology and on the structure of the earth's crust and the nature of sculpturing processes, the normal cycle of erosion is broadly treated in eight chapters, even to the point of describing resequent drainage. Then follow as many more chapters on special topics, such as faults, block mountains of which the southern island of New Zealand offers admirable examples, land forms built of rock waste, and interruptions of the normal cycle by crustal movements. Next comes a chapter on wind action, this subject being briefly treated because New Zealand includes no desert areas, four chapters on glaciers and glaciation, two on volcanoes, and four on coasts. All the chapters are copiously illustrated with ideal diagrams, landscape sketches, and half-tone views of local scenery, making 442 figures in all. The success with which type forms are matched with actual forms testifies to the remarkable physiographic wealth of New Zealand. A list of 101 reading references, including 20 titles by the author, and a good index close the volume.

The discriminating quality of Cotton's treatment may be indicated by a few extracts from his pages. The introduction states that the description of land forms must be explanatory in giving some account of their geological origin and yet that it must also be geographical in that it shall not distract attention from present form to a consideration of past geological processes. Brevity is secured by the use of an explanatory nomenclature. Concerning the relation of uplift by which a cycle of erosion is initiated, to erosion by which it is carried on, it is remarked that "it simplifies the elementary study of land-forms to regard this uplift as rapid. It is not to be regarded as ever sudden, or catastrophic, but it may take place so rapidly that the amount of erosion that goes on during uplift is small

as compared with that which follows completion of the uplift. All uplifts are not so rapid as this, but the results produced by erosion will ultimately be very much the same whether the uplift is slow or rapid." As a mark of the author's devotion to the truly geographical aspects of geomorphology it may be noted that, in strong contrast to the highly geological treatment of the subject by German geographers, Cotton excludes all geological time names, even in the case of fossil peneplains in certain block mountains. Readers who wish for geological information about New Zealand can find it in Park's or in Marshall's handbook.

When Cotton's next volume, on the regional morphology of New Zealand, now in preparation is issued, that compact country will be better equipped with physiographic texts than any other similar area in the world.

W. M. DAVIS

## THE PHYSIOGRAPHY OF EUROPE IN DIAGRAMATIC FORM

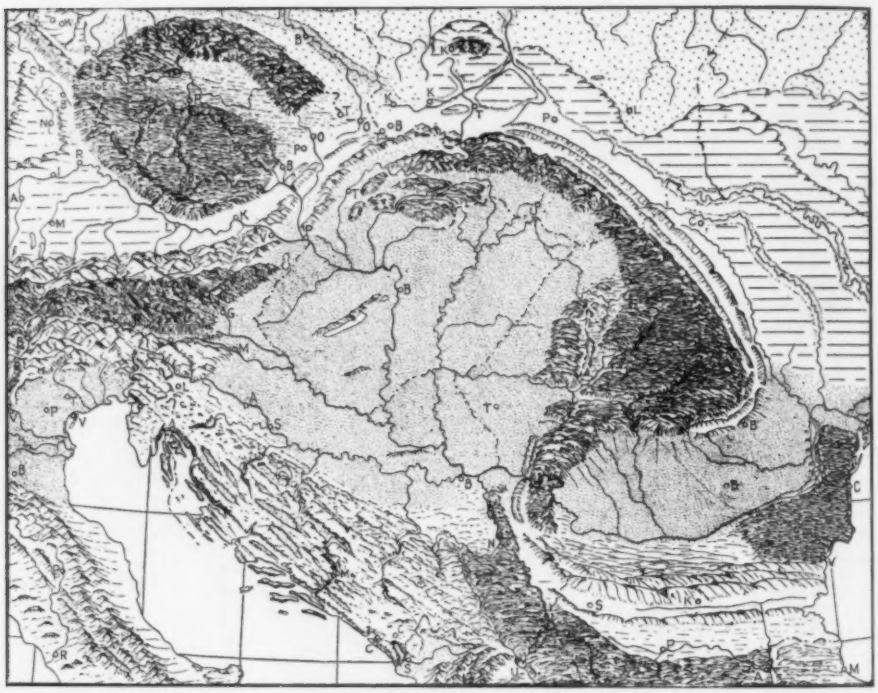

FIG. 1—Portion of the "Physiographic Diagram of Europe" reproduced on a slightly reduced scale—approximately 200 miles to the inch.

A. K. LOBECK. **Physiographic Diagram of Europe.** Small scale edit. Scale, approximately 1 : 9,000,000, or about 150 miles to one inch. 2 pp. of map and 6 of text. Wisconsin Geographical Press, Madison, Wis., 1923. 35 cents. 19 x 12 inches.

Professor Lobeck has furnished an admirable aid to the teaching of the physiography of Europe, following upon a similar device for the United States (1922). Omitting meridians and parallels from the land he has filled the space occupied by it with sketches and sketchy effects that represent the relief in more detailed expression than has yet been achieved upon our wall maps. Naturally the drainage is included; and upon the drainage lines, as well as in a few other localities, are placed the initial letters of towns so that the student may find his way about upon the political or commercial map in the event of comparisons with the physical map. To illustrate the character of the diagram a small portion of it is given above (Fig. 1) on a slightly reduced scale which approximates 200 miles to the inch. Near the center of the upper left-hand quadrant of Figure 1 is the letter "V" which stands for Vienna. Between it and the upper edge of the map is the basin of Bohemia.

The great central plain of Hungary is in the center of the map. The limestone ridges of the Karst country border the Adriatic, and its island-strewn coast suggests the manner in which the coast of Norway is treated. The scale is too small to permit a detailed representation of the relief of the Alps. One does not see the terminal moraines, and only for those who know where to look are the cirques expressed or suggested ever so faintly in the mountain forms of the Tyrol. West of the rim of the Bohemian basin are westward-facing escarpments which step down to the Rhine Graben outside the sketch on the west. The generally broken character of the Balkans is depicted on the southern edge of the diagram. A corner of the "Baltic plain" is represented by the stippled area under the upper frame of the map.

The map is accompanied by six pages of condensed text, consisting of thirty-seven numbered paragraphs, each one dealing with a principal physiographic province. A very great deal of useful information is compressed in these large pages, which measure nearly a foot in width and a foot and a half in height. Without seeking to diminish in any way the high value of the map and its accompanying text and exercises, a slight suggestion may be made with reference to the explanatory touches which are found in nearly every paragraph. These explanatory sentences ought to be thoroughly revised in the next edition. Without unduly emphasizing the defect which they represent, two of them may be given as samples, one in the field of physiography and the other in the field of human geography. "Its broken and discontinuous character is due to the numerous embayments of the sea. . . ." One rather supposes that this feature of "The Northwest Highlands with Associated Lowlands" has been gained as a result of depression of a well-dissected surface together with other agencies and that the broken character and the numerous embayments are alike consequences of the action of common agencies.

"Since this mountain district [the part of the Carpathian region that lies in eastern Czecho-Slovakia] has neither mineral wealth nor fertile soil, the Slovaks inhabiting it are a backward, depressed people with little aptitude for industrial life." The sentence might express a truth had the word "since" been omitted. As it stands it suggests the inquiry whether jollity and high spirits are necessary accompaniments of mineral wealth and fertile soil and depression the result of the absence of these two resources. Have the Slovaks really little aptitude for industrial life or rather little opportunity for exercising such aptitude as they may have?

## A Study of Earthquake Frequencies

L. A. Cotton. **Earthquake Frequency, with Special Reference to Tidal Stresses in the Lithosphere.** Diagrs., bibliogr. *Bull. Seismol. Soc. of America*, Vol. 12, 1922, No. 2–3, pp. 49–198.

The greater part of Professor Cotton's interesting paper is a complete historical and critical résumé of the statistical work done in the attempt to correlate earthquake frequency with the seasons, the tides, the positions of the sun and moon, etc. The results of the immense amount of study along these lines have been disappointing. It is generally recognized that the principal cause of earthquakes resides in the earth itself, and that the influence of the seasons or of the heavenly bodies can only be of secondary importance, perhaps slightly advancing or delaying the actual time of occurrence of an earthquake. And so the investigators have discovered possible periodicities, with a greater frequency, by a small percentage, under some conditions than under others. But the results are by no means accordant, and the reviewer is inclined to believe with de Montessus de Ballore, that the periodicities obtained are accidental and do not reflect a real physical law. It must not be forgotten, however, that many competent students of the subject think otherwise.

The statistical method cannot explain earthquakes, it can only suggest an explanation; and so far it has not discovered anything of importance except the negative conclusion that no influence from outside the earth has any great effect on the frequency of earthquakes. In some cases it is difficult to imagine any possible cause for the period found. For instance, Omori found from three to six maxima within a 24-hour interval. What could cause such periodicities? The statistical method as applied to earthquake frequency is something like searching for objects in a dark room when you do not know in what part of the room to hunt and are not even sure the objects are there. To be sure, it is not always so bad as that; but undoubtedly earthquakes have sometimes been grouped by investiga-

tors in a way to hide a periodicity which, under a different grouping, might possibly have been found. The most promising procedure (which has been followed in some cases) is to determine the dynamic result of a given cause and then to see if the cause has been effective. Professor Cotton has followed this method in the latter part of his paper and has sought the position on the earth where the tidal forces due to the moon would have the greatest tendency to cause an earthquake. But, unfortunately, he has simplified the problem too much. G. H. Darwin, in his paper "On the Stresses caused in the Interior of the Earth by the Weight of Continents and Mountains (*Phil. Trans. Royal Soc. of London*, Vol. 173, 1882)," has solved the general problem, under some restrictions, of the equilibrium of a homogeneous, non-compressible, elastic earth under the influence of tidal forces. He finds that everywhere at the earth's surface the principal stresses would be perpendicular and parallel to the surface; therefore the greatest shearing stress would make an angle of 45° with the surface, and its greatest intensity is when the moon is in the horizon.

Professor Cotton's long historical résumé will be very useful to students of seismology; and he has made a good point in emphasizing the necessity of dynamical guidance for the successful statistical study of earthquake frequencies.

HARRY FIELDING REID

### WEATHER-FORECASTING REDUCED TO A SCIENCE

L. F. RICHARDSON. **Weather Prediction by Numerical Process.** xii and 236 pp.; maps, diagrs., indexes. University Press, Cambridge, 1922. 11½ x 9 inches.

This rather large volume by the former Superintendent of the Observatory at Eskdalemuir, Scotland, and at present Lecturer in Physics at Westminster Training College, is a remarkable book, perhaps the most remarkable of all meteorological treatises. It can have but a limited number of readers and will probably be quickly placed upon a library shelf and allowed to rest undisturbed by most of those who purchase a copy. It is a strikingly bold attempt to wake up weather forecasters; indeed, to make forecasting a science rather than an art.

The author alludes to Colonel Gold's "Index of Weather Maps" (*Meteorol. Office Geophysical Memoir No. 16*) in which the past history of a portion of the atmosphere over northwest Europe is used as a full-scale working model to indicate the current and consequent weather. But there is no valid reason for expecting to find in past weather maps facsimiles of current maps. Hence let us use processes resembling those by which the Nautical Almanac is produced, founded on differential equations and not upon "partial recurrence of phenomena in their ensemble."

The book had its origin in 1911 when the author became interested in the use of finite arithmetical differences in handling differential equations. The fundamental idea is that atmospheric pressures, velocities, etc., can be expressed as numbers and tabulated at certain latitudes, longitudes, and levels. Then, operating by an arithmetical method, new values for any given time interval can be obtained.

There is, however, a fatal weakness in the scheme in that local disturbances, or in the author's phrase "small-scale phenomena," must be smoothed out. But in our daily weather it is the small-scale phenomenon, or departure from the general flow, which works havoc with the forecasts.

Also in the integration of the fundamental equations, mean values are used. Now most observers know such values are not even the most frequent values.

The author excuses the failure of his method when applied in the one forecast made, by saying that it is "spoilt by errors in the initial data for winds." He believes that the pilot balloon stations were too irregularly distributed and too few. Such a confession, however, gives aid and comfort to the professional forecaster of today; and he will continue to rely upon surface conditions.

There are many unique signs and symbols and a much-needed page of guiding signs. Energy is expressed in ergs, not calories. The final chapter on "Units and Notation" will try the patience of most readers. A number of Coptic letters are introduced, lower case and upper case English and Greek alphabets plus all known mathematical signs not being sufficient to meet the author's need.

It took Professor Richardson six weeks to draw up certain computing forms, but he thinks an average computer would go ten times faster. To "race the weather," as he puts it,

for the whole globe would require 64,000 computers. This leads him after much hard reasoning to play with a fantasy—a mental picture of the chief office of a World Forecasting Institution. But he does not lack a sense of humor, and in discussing possible analytical transformation of certain equations so as to shorten the process and incidentally give the public what it wants—namely, wind, rain, temperature, and radiation—he quotes the case of the philosopher who reduced all physics to a single equation. But it needed 12 large volumes to explain the symbols used in that equation.

ALEXANDER MCADIE

## A SIXTEENTH-CENTURY BELGIAN GEOGRAPHER

FERNAND VAN ORTROY. **Bio-bibliographie de Gemma Frisius, fondateur de l'école belge de géographie, de son fils Corneille, et de ses neveux les Arsenius.** 418 pp.; ill. *Mémoires Acad. Royale de Belgique, Classe des Lettres et des Sci. Morales et Polit.*, Ser. 2, Vol. 11, Fasc. 2. Brussels, 1920. 10 x 6½ inches.

During the sixteenth and early seventeenth centuries the Netherlands led the world in scientific geography and in the art of cartography. Mercator and Ortelius, Hondius and the Bleaus are stars of the first magnitude in the history of these studies. Less well remembered, but none the less a leading figure, was Gemma Frisius (1508–1555), professor of medicine and mathematics at the University of Louvain, teacher of the famous Gerard Mercator. It would seem that nearly everything there is to be learned about the lives and bibliography of Gemma Frisius, his son, and his nephews has been gleaned by Van Ortroy and gathered together in this scholarly volume.

There is much meat here for the historian of geography who would dig it out. It means digging, however, for the salient facts are buried in a mass of less important details and bibliographical minutiae, and there is no index. Much is told of the work of Gemma Frisius, Cornelius Gemma, the Arsenius brothers, and their colleagues; but those who seek to learn where this work stands in relation to contemporary thought or to the history of science and of geography must supply their own background.

Though a student and professor of medicine—in the practice of which art as well he was by no means unsuccessful—Gemma Frisius by taste and talent was a cosmographer. Teaching, research, and publication in the field of cosmography, which includes much that is astronomy and mathematics as well as much that is geography, were for him more than avocations. They formed a second profession, as it were, in which he gained for himself a lasting reputation. His medical work is all but forgotten. The high quality of his cosmographic work was widely praised at the time and even won the recognition of the Emperor Charles V. Some of the compliments lavished upon him by contemporaries were possibly extravagant. Van Ortroy holds that in general he revealed less scientific originality of the highest order than of deep learning coupled with a sharply critical spirit. Gemma's thought was always more practical than theoretical, directed toward the devising of instruments and methods, the construction of globes, and the writing or editing of books to serve the practical needs of man.

From the geographical point of view, one of Gemma Frisius' most significant productions was a large map of the world, now lost, but whose character can be determined in a general way from extant descriptions. What is probably a small cordiform reproduction of this map has been preserved. The Belgian cosmographer also compiled and supervised the construction of terrestrial and celestial globes, one of the former having been engraved in part by Mercator. Gemma's version of the famous "Cosmographia" of Peter Apian went through many editions. Besides this, he composed a cosmography of his own, entitled "De principiis astronomiae et cosmographiae," in which a discussion of the principles of astronomical geography is followed by a geographical description of the regions of the world including the "islands recently discovered." Extensive extracts from the "De principiis" were inserted in some of the later editions of Apian's "Cosmographia."

Two passages in the writings of Gemma Frisius, which foreshadowed developments of fundamental importance in the arts of surveying and of navigation, reveal to us his practical and inventive cast of mind. The first is in a short treatise called "Libellus de describendorum locorum ratione," which was inserted in Gemma's editions of the "Cosmographia" of Apian after that of 1529. Here the use of triangulation as a basis for the construction of maps was first suggested. The writer proposes that an observer on the cathedral of Antwerp measure the angles formed between the meridian and the directions of other cities in

sight, Brussels, Malines, Louvain, Ghent, etc., and plot these on a piece of paper. By repeating this process at a vantage point in one of the other cities he shows how it is possible to determine the relative positions of the cities by intersection. The other passage is in the ninth chapter of the "De principiis astronomiae et cosmographiae." Here it is shown that longitude might be determined by the use of small clocks. This method, upon which modern navigation in large part is based, did not become practicable until the eighteenth century, owing to mechanical imperfections in the construction of chronometers.

### America and Mongrelism

C. W. Gould. **America, a Family Matter.** 196 pp.; map, diagr., ills., index. Charles Scribner's Sons, New York, 1922. $3.00. 9 x 6 inches.

"Human intelligence has waxed and waned. Many factors caused its decline from the great age of Pericles to the darkness of the eighth century. The endeavor of this essay is to search out the principal or fundamental cause of that mental degradation. The result is taken and applied to conditions now existing in our own country—America."

Such is the argument which prefaces the text of this volume. Why has not human progress been uninterrupted and of some definite and specific trend? The question has frequently agitated the minds of scientists as well as of historians; and conclusions which differ *toto caelo* one from the other have been arrived at. In the view of some the extraordinary deviations and fluctuations of humanity are due to an altogether natural process of growth and decay, attended by the springing up of new life. Others have suggested meteorological considerations; still others have argued the claims of economic pressure; geographic, hygienic, and ethnological theories have likewise been disseminated. But the matter is still a great deal of a puzzle.

Mr. Gould, who is not, apparently, a specialist in any particular field of learning, attacks the problem, if not from a new quarter, certainly with a fresh and interesting point of view and with a unique treatment. His imagination, it would appear, has been vastly stirred by observing the "mongrel" type among animals and biological causations through which the type is produced. He has, on the other hand, been much impressed by the virtues and merits of the "thoroughbred." So Mr. Gould adopts the simple stratagem of examining the pages of history with an eye to the effects produced upon the human race by the occurrence from time to time of mongrelism, which seems to alternate with pure-bloodedness. Somewhat artificially it would seem, he has divided the course of history into ten semi-millennial periods, commencing with the dawn of Egyptian history about B.C. 3500 and concluding at the year A.D. 1500; though it is not easy to see why the modern period should be thus slighted. Indeed, the entire Christian era is treated in some ten pages of the book, while upwards of eighty-five pages are devoted to a study of the Seventh Period of human activity—from B.C. 500 till the time of Christ. A top-heavy system of this sort surely loses much of its effectiveness.

An examination of those ancient peoples, the Egyptians, the Persians, the Greeks, and the Romans—their art, literature, ethics, course of progress, and political regimens—has led Mr. Gould to adopt the conclusion that each race and nation was at its best and greatest when its blood was purest and freest from foreign admixture. But as surely as the state becomes strong and prosperous, the alien is attracted into it. Fusion of blood results, at first gradual, finally on a grand scale; thence, mongrelism and degeneracy, resulting ultimately in total *Niedergang*. The nation that would keep its feet in the struggle for existence must needs keep not only its civic life pure but also its stock free from external contamination. It therefore behooves America to gird up the loins of her mind and exclude, at all hazards, the pernicious foreign element.

Mr. Gould may very possibly be correct in the main; he has, at least, on his side many eminent and sagacious authorities, including the veteran scholar of Columbia University, Professor H. F. Osborn, who maintains that the "melting-pot" theory is all wrong. But, however this may be, "America, a Family Matter" can hardly be termed a convincing or even a well-written book. The author has not taken time to clear the ground as he advances to the attack and so frequently falls into the barbed entanglements of erroneous statement. In spite of the occasional attempts at fine writing, his style contains something more than a suggestion of immaturity and even puerility. There is also a sad lack of proportion about the whole scheme of the book, and it is very manifest that the writer

has failed to steep himself in historical lore. At least a score of lapses and blunders catch the eye, even on a rather hasty perusal.

Notwithstanding all this, one would be glad to see the theme developed and the theses of the book subjected to careful examination. Mr. Gould has given us a note of warning on a theme that deserves attention.

ALEXANDER DAVID FRASER

### A TEXTBOOK IN ECONOMIC GEOGRAPHY

ELLSWORTH HUNTINGTON AND F. E. WILLIAMS. **Business Geography.** x and 482 pp.; maps, diagrs., ills., index. John Wiley & Sons, Inc., New York, Chapman & Hall, Ltd., London, 1922. $2.75. 8½ x 5½ inches.

This is a textbook for senior high school, business college, or for the first-year course in schools of commerce. It is not a compendium of useful knowledge for the business man or the embryo business man; but it is a textbook dealing with principles that govern the environmental influences affecting the production, exchange, and consumption of commercial products. It is wholly unlike economic or commercial geographies now in use in that its organization is along entirely new lines and also in its prominence of principles rather than facts. Indeed, the authors state in their preface that a course in economic and commercial geography is presupposed.

The subject matter is arranged in four parts, with a fifth part consisting of statistical tables. Part I (133 pages), entitled "The Geographic Principles of Business," discusses the great factors affecting business—climate, relief, soil, rain, transportation, etc. Part II deals with the business relations of typical communities—pastoral, dairying, temperate zone farming, tropical plantations, lumbering, mining, manufacturing, etc. Parts III and IV discuss the business of the continent and of the United States and Canada particularly. In these sections the authors approach the regional treatment yet describe only the main factors affecting production, consumption, and trade in these large regions. A very useful feature of the book is Part V which consists of 49 tables of data on area, population, occupation, land values, farm tenure, agriculture, mining, quarrying, lumbering, manufacturing, transportation, commerce, consumption, finance, education, and health. These tables, however, are something more than an appendix in that exercises and problems at the close of each main division of the text call for their use.

The work is original in its organization, scholarly in its treatment of principles, illustrations for which are drawn from the whole world, and will prove a valuable text. It will also prove interesting as a supplementary reader in the courses other than those for which it is intended as a text.

A. E. PARKINS

### THE EXPLOITATION OF THE ARCTIC

VILHJALMUR STEFANSSON. **The Northward Course of Empire.** With an Introduction by E. W. Nelson. xi and 274 pp.; map, diagr., ills., bibliogr. Harcourt, Brace & Co., 1922. 7½ x 5 inches.

This book is one that all economic geographers should read. It opens with a chapter which will delight geographers with its rich collection of facts proving the geographic ignorance of statesmen and our steadily increasing appreciation of northern lands. Here is one of these gems. "In 1763, at the end of seven years of war England and France made a treaty. The British, feeling that they were in a position to do so, asked among other things that the French turn over to them the island of Guadeloupe. To this the French replied in substance that they disliked extremely to give up Guadeloupe, as it was an island containing sugar plantations of great value to the citizens of France, and suggested they would much prefer to surrender Canada. To this the British replied that while Canada was larger than Guadeloupe, it was not good for much. There were, of course, some furs, and there were codfish on the Newfoundland Banks; but on the whole it was not a very valuable piece of property, and they much preferred Guadeloupe. After a prolonged deadlock Benjamin Franklin suggested through a pamphlet that, while Guadeloupe was more valuable than Canada, it was a distant island, while Canada was contiguous territory, and if we allowed the power of France to develop at our very door there would be continual friction. Eventually the British accepted Canada, apparently for

political rather than economic reasons. And now not half of the readers of this book can find Guadeloupe without looking it up in the index of an encyclopedia."

One of the most important sections of the book gives a convincing statement of the now fairly well known fact that the Arctic tundra is in the process of becoming a great range or ranch for the reindeer farmer. Mr. Stefansson also advances convincing arguments to the effect that there is also great wealth to be added to the world's store by the domestication of the musk ox, Mr. Stefansson's "ovibos," an animal of surprising abilities at living in the open Arctic lands, picking his living, producing meat, wool, and possibly even milk. He also rather shames us by pointing out that we have not domesticated any animal of importance for the last 2000 years.

Plainly, the tundra is good for reindeer; and doubtless peoples native and accustomed to this zone can easily populate it. It is hard to understand how it could have any *home lure* for persons who know any other land. It is true that Mr. Stefansson loves it, but it is hard to understand how he can, after saying, as he does,

"Admittedly there will be some suffering during the period when the temperature ranges between 85 and 100 degrees in the shade, for prevailingly the North is humid and the heat will therefore have its fullest disagreeableness." . . .

"No matter how hot you are, you will have to wear thick enough clothing so they [mosquitoes] cannot sting through, with unpierceable gloves on your hands and a veil over your face." . . .

"Some say the sand flies are worse than the mosquitoes because they will get inside of your clothes and crawl all over you. This can be dealt with by wearing knitted cotton or woolen underwear that grips the body so tightly that flies cannot crawl under. That is a simple enough way theoretically but finds its objection in the fact that one does not like to be clothed that way when the temperature is around 90°."

Chapters on the advantages of the Arctic for aerial navigation bring out many interesting things, among them the shortness of the polar route between such places as London and Tokio and the superiority of the Arctic sea over any other sea for air travel because of the ease of sailing down to make repairs upon ice cakes rather than upon the bounding billows of the open seas.

J. Russell Smith

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